FRED'S FLYING FLEA.

HM 290/3 FB.

HOW I BUILT IT.

BY FRED BYRON.

FORWARD.

I HAVE CHANGED THE FORMAT OF THE HM 290/3FB DRAWINGS AND CONSTRUCTION NOTES FROM A4 TO A5 SIZE. THE MAIN REASON, IS THAT POSTAGE COSTS ARE MORE EXPENCIVE TO OVERSEAS DESTINATIONS.

NEXT I AM ENDEVORING TO DO THE PRINTING AND BINDING MYSELF. I ADMIT AS YOU SEE AM NO EXPERT, BUT AGAIN COST REARS ITS UGLY HEAD. I DO HOPE THAT YOU CAN FOLLOW. MAYBE A GOOD READ WILL HELP YOU FIND THE INFORMATION OR DRAWING YOU ARE LOOKING FOR.
YOU MAY RUN ACROSS SOME NOTES I HAVE MISSED LIKE (SEE DRG ?) PLEASE IGNORE.
I AM ENCLUDING A FEW LOOSE PAGES AND A C.D. OF PHOTO'S TAKEN DURING CONSTRUCTION AND AFTER. THERE SOMETHING APPROX, 70 ODD SNAPS.
I HAVE BEEN AROUND AIRCRAFT FOR THE BEST PART OF MY WORKING LIFE IN SERVICING AND CONSTRUCTION. I REALISE THAT THE MORE INFORMATION THE BETTER. CONTACT ME FOR ANY ENQUIRIES BY EMAIL.

INTRODUCTION.

IN THE TRADITION OF "HENRI MIGNET"

I first came in contact with the Flying Flea in the mid 40's in an aircraft Co overhauling wooden aircraft. This is where I got my love for the wooden AC. During this time I read the Flea book and was able to see a new one stored during the war. The colours, of course, blue and silver.
In the early 90's I saw a HM14 built by Tom Cadet of Kyogle at a fly in and the bug bit me again.
Now retired after spending the best part of my working life in the aircraft and auto industries I decided to build a HM 290/3 and with some modifications call it the HM290/3FB.
I later obtained Tom's 14 and modified it. Added a 503 and a fin and rudder, extended the fuselage and a few other mods.
Before this I built a version of Henri's HM 290/3 design which has proved to be successful. That is why I am trying to put what I did down, as it may help others.
I can not afford to have this published as it has a limited public. So I am doing it myself and am getting a bit frustrated at the problems I face.
I wish to thank those who have helped along the way. These include in alphabetic order Tom Cadet, Richard Fraser, Robin Germon, Bob Goodie, Joe Kostevc, Phillip Howell, Kirk Sutton and Garry Morrison, plus John Blackler and others.
As with all these Ultra Light AC the responsibility is with you the builder to construct to good practices with suitable material. I advise getting someone to check your work. Centre of gravity range is like in all AC important.
You will find at the back of this book some ideas that have been used in similar cases that could be adaptable to your project to suit your capability or tools available.
So good luck in your endeavours.

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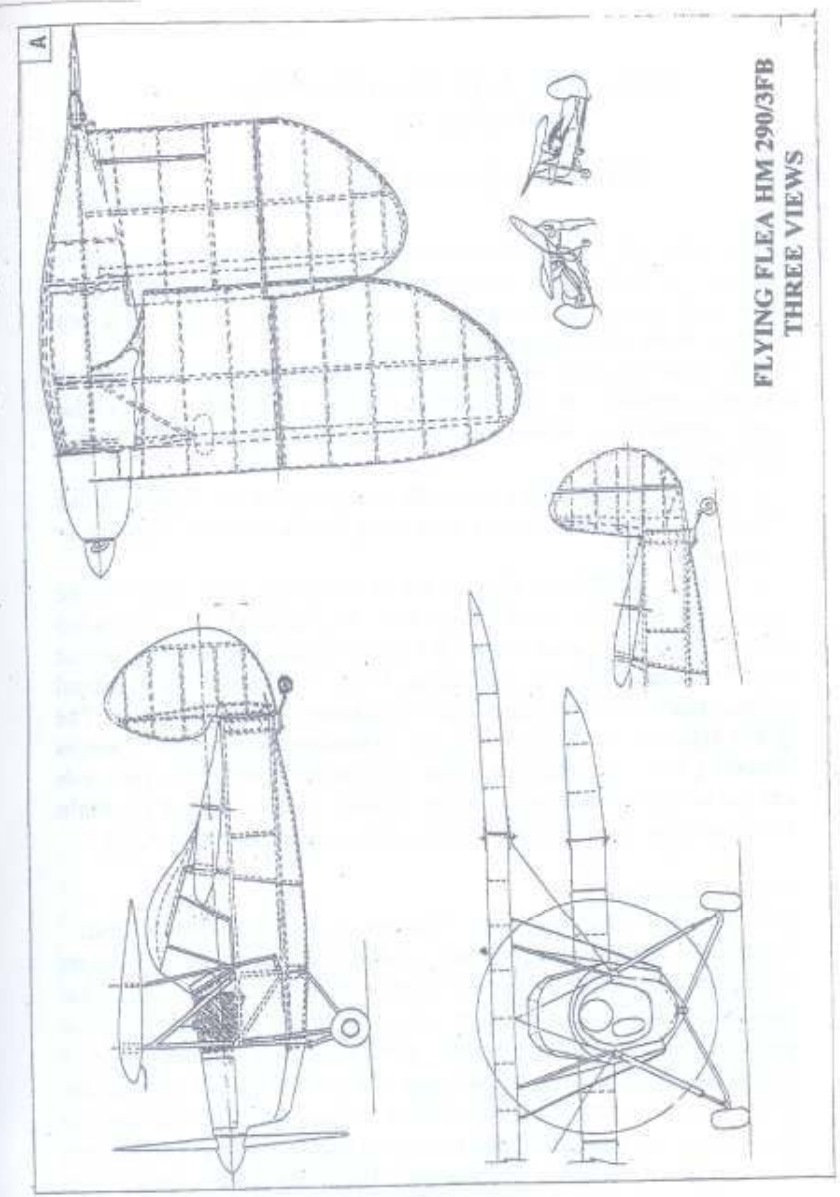
A FLYING FLEA.

ORIGINAL DESIGNED BY
HENRI MIGNET.
THIS ONE BUILT BY ME
FRED BYRON.
HM 290/3FB.

WING SPAN : 6.1M FWD WING
REAR WING: 4.2M.
HIGHT: ABOUT : 1.8M (DEPENDS ON UC TYRES ETC)
LENGTH : WILL VARY ACCORDING SOME ASPECTS.
FOLDING WINGS: YES
FUEL CAPACITY: ACCORDING TO TANK SELECTED.
MOTOR: A ROTAX 503 WORKS VERY WELL. 40 TO 50 HP IS A GOOD RANGE.
PERFORMANCE WILL DEPEND ON MOTOR AND OTHERVARIATIONS. SEE PILOT NOTES BY KIRK SUTTON.
STALL: AGAIN SEE NOTES.
EMPTY WEIGHT ; AROUND 155—165KG. THIS WILL DEPENDON MATERIAL AND EQUIPMENT.
GROSS WEIGHT: AT BUILDING TIME WE WERE RESTRICTEDTO 300KG.
RATE OF CLIMB: DEPENDS ON MOTOR ETC (BUT GOOD)

THIS PARTICULAR AIRCRAFT HAS A 5.85M FRONT WING.



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PAGE 55 TO 138 DRAWINGS AND IDEAS.

PAGES 39 to 52 PILOT NOTES.

BUILDING THE FLYING FLEA
HM 290/3 FB

CONSTRUCTION NOTES.

These notes and drawings are how I constructed a Flea. I do this to explain how and why I went about it. Things I found, changes I made and reasons for doing it. I do it in the hope it may help a new builder. Some things apply to any aircraft.

Quick note. I started in the aircraft industry during the 1939 /45 wartime, working on wooden aircraft. Since then have worked for many aircraft companies and for sone years my own. The rest is another story.

Now take note what I say is not the only way to do things. So ask around and read all you can and then decide what or which way suits you.

You will see a different type of rib construction in a photo of the centre section of the front wing which was damaged in a bad wind shift on take off. I used the girder type ribs as they are lighter but slower to make but it's your time. I had run out of the diagonal grain, satin coachwood ply that I had stored for many years. The girder type is also cheaper to make. I also made some other changes including the HM 380-type hinge installation where the spar ends are not sealed so shorter bolts can be used. It is very hard to obtain the long bolts. Also drilling requires the use of a special drill jig.

OK lets get to work.

First as you will be using a lot of timber we will talk about it first.

There are a few types you can use, such as Spruce, Hemlock, Douglas Fir, Hoop pine, Baltic Pine and I believe in the past even Poplar has been used. One builder in South Africa is using an Australian timber grown there as a plantation timber called Rose Gum (Flooded Gum) it is a bit heavier so keeping to the lower tolerance on sizes is a good idea. There are a few ways to cut your timber. A good table saw that does not leave heavy saw marks. A good saw cut is best for gluing. You can saw then run through a busser (thicknesser). But it has to have sharp blades or, it will compact the grain and when left it will try to come back leaving an uneven surface that will need sanding. Look at the next pages and you will find a test procedure to follow. But remember read all you can lay your hands on about timber and its selection for Aircraft use.

When cutting the timber try to have the grain across the narrower face. That is on a rectangle the grain goes across the short measurement. Or as near to this as possible. With a square it does not apply, but you knew that. When cutting you material list try to cut you requirement at one time so as to keep the same size. This applies when fitting more than one piece into a cluster joint that will have gussets fitted.

FUSELAGE. THE FUSELAGE WILL BE CONSTRUCTED UPSIDE DOWN

You will need a table about 2500mm long, made from ply are particleboard say 20mm or more thick mounted on some type of stands and checked so it has no twist.

Mark out the fuselage plan full size and screw on some blocks on the inside where the longerons will go. These blocks are set back 20mm and an extra 20mm for the front section where it is 40mm thick. It also does not hurt to put some say 6x10 mm blocks alongside your main blocks. These can have some plastic tape applied on top to prevent your laminations sticking. Now you can laminate the longerons doing the short inside ones first. Use 2- 21x10mm pieces. The extra 1mm is to allow for clean up. When dry you can then attach the long laminations. Don't try bending the 20x20mm it leaves too much spring. When dry they can be cleaned up and returned to the jig.

It is no good using varnish to protect you jig, as the glue will still stick. Use plastic or Sellotape.

Now you can construct the frames, in P2 you will see an alternative frame shape. This is straight sided. It will give a bit more side width at the posterior area. You can assemble the frames but be careful when cutting out the corners, as there is some sloping to be done in places.

Keep checking. You can glue on small bits of timber to keep the frames in place while fitting. Use a thin piece of timber to mark out for the 30x15mm side members (These will also be laminated). The same applies for the keel members. Frame 2 can be held in place with a temporary structure.

When it comes to shape the angle for the plywood use a hand plane with the nose modified, that is rounded off the front corners so the sharp edge does not bang against the frames or other members. A sanding board is also helpful. A 10-inch bastard file is very good for all kinds of clean up work. I recommend Epoxy Glue. Try to do no gluing if the temp, is below 20deg C or humidity over 70%. More later.

SEE 58 59

PLYWOOD. There are several types you can use. This will depend on your locality. I use birch for the spar webs, or a ply of similar strength. Then hoop elsewhere. You can use mahogany gaboon or what ever is in your area. Birch needs to be sanded lightly in areas to be glued. Do the same to any ply that has a, what might be called a shiny surface. Take note of grain direction shown on Drg's for spars, leading edge, rib gussets, trailing edge gussets etc.

METAL. Most early Flea drawings called for mild steel fittings. For components such as cabane, wing hinges, strut straps I used 4130. Be sure to use the correct bend radius. I see a steel manufacturer has a construction steel called "DURAGAL" that is stronger than ordinary mild steel sheet and tube. I have cut angle brackets out of this for my present project. Originally 2mm sheet was called for except the hinge lower plate. If you look at 4130 sheet you will see writing giving the spec, etc this shows the grain direction. Always try to make your bend line at 90deg to this. Always best to get a certified welder to do your welding. Your choice.
One thing more at this time. A good edge is required on your fittings especially if bending. (SEE drg 27) where I rad the edge this gives what could be described as a thinner sheet and helps to prevent cracks developing during bending. 14

FABRIC COVERING. Use a system that all materials are compatible. If rib stitching is not going to be used (But I recommend stitching or small screw and washer's in the prop blast area of the front wing) use about 70mm spacing for the screws and you don't need to go much past the rear spar.
The interior of your wings etc need a protective coating to prevent damage to the wood by water or fungus etc,
I use a 2-pack epoxy treatment, which is thin enough to penetrate the surface.
I use in the area of prop blast on the top of the front wing , apply a tape over the fabric at the rib about to reinforce the fabric, then at about 70mm intervals back to about the rear spar, use small PK screws and washers to hold the fabric (Still bond the fabric.) Then apply the finishing pinked tape. The main reason we use this tape is to create a transition thickness to prevent the fabric finish from cracking next to the rib due to flexing of the fabric in flight.

NOTE! The timber treatment being epoxy will seal the timber. (Wont hurt over metal fittings) but be sure to put some on the timber before assembly of fittings. **DO NOT PUT ON SURFACES WHERE YOU WILL BOND FABRIC. EPOXY AND POLY FABRIC ARE NOT COMPATIBLE.** In fact scrap fabric can be used as peel ply in GRP lay-up. (See Cowl section)
If the system of bonding fabric to the structure. (See: 74-76-79-81 and add glue strips of ply 15to 20mm wide. This will give a good bond area for the fabric. Obtain a copy of the fabric supplier's and finishing paints procedures. There are many books on the subject. I will later explain some tests I have carried out.

CONTROL CABLES. I used (1/8") 7x19 cable for the rudder. I did not use pulleys at the fuselage sides because it would require pulleys about 4" in dia. There is a limit as to how much bend you can use depending on the cable diameter and bend required. If say you used 3/32" cable the pulley size would be smaller. So I used the bent tube method. I found by asking around that it works. A rudder bar or pedals would make the control system simpler. On my present project I am using a rudder bar and even a side stick. This will make getting in the aircraft simpler.
Some Flea builders have used 5mm cable for the strut with double Nicopress fittings and turnbuckles. I used the 4130 strap system on the 290/3 and the tube and threaded end system on the HM14. What is available will dictate what you use.

FIREWALL. Depending on local requirements you can use .012" stainless steel or .016" galvanised steel. But first decide on the fuel tank and turtle back tank cover. This can include the instrument panel, even the windscreen, and be made removable to gain access.
When you fit your engine mount and other accessories to the fire wall you match up the holes. But remember when all is done remove to de-bur the back of the firewall. Be sure any cables or wiring looms that pass through are sealed with grommets or similar. Some treat the forward face with a series of brushed circles for appearance sake. I does look nice.

FUEL SYSTEM. Depending on the motor used it may be necessary to fit an outboard motor type squeeze primer, within reach of the pilot without him undoing his safety belt. Always add a water drain in the lowest part of the tank or you may fit a Gascolator filter. Some of these have a water drain in them. Some kind of fuel pump is needed, either as part of the motor or an electric one. For fuel lines use what ever is used locally. Try to avoid hanging bends in lines it may help to prevent vapour locks. You will find a tank cap drawing later that I use. Diameters may be varied to suit, but the place where the "O" ring is make sure the lip does not become disengaged when undoing.

INSTRUMENT PANEL. Your use will dictate which ones you will fit. A simple 3mm-ply panel will do. Remember leave enough room between the instruments and the tank for plumbing. A.S.I.,ALT, Rev counter, Cyl head temp and maybe E.G.T. I have heard that if a slip skid is fitted it will never leave the centre.

RIBS. There have been several airfoils used in the past but Henri Mignet advised using the one used on the HM360. This is his 34-013 airfoil. You can layout a full size shape on plywood or the white-faced pine board. For the A type rib I would suggest being a little more particular as you will be making more of them. Glue on small blocks to shape your rib caps, and if using girder type ribs some to keep the members in place while fitting gussets. I use small cams made from 6mm ply to lock the front spar vertical in place and also the rear spar ones are important. They govern how well the wing assembles. I do not glue the member behind the spar; this saves maybe filing it when you are assembling it. Because slight variations in timber and ply thickness can be a problem. Besides that when you do glue it in it will fit correctly. The nose block can be varied to suit your own capability.

I made some false nose rib shapes (See sketch later) and soak the ends of the rib cap and pre-bend the ends. Watch for grain swelling after they are dry.
There are other rib profiles available such as Richard Fraser's F Series. Some people say use a 14% or 15% section seeing as you are flying in the 100MPH or less area and the extra lift out weighs the bit of drag.
If you use a good and accurate jig the assembly will go much better.

SEE PAGE 11—121. ⟶

Some people use a potato peeler to remove a little off the edge of the rib members or sand, or even file the edge. It looks neat may save a few ounces. Up to you. Full-faced ply ribs are easer to make but ply is more expensive. So which is more important to you the extra dollars or your time. I like making ribs so I use girder type. Except on the first one I used some diagonal grain Satin Coachwood ply I had to spare. (Had it for a while).

Page 72. shows the rib stock at 12x6mm but if you are going to bond fabric rather than stitch you can reduce this to 10x6mm. As I consider 10 or 12 mm minimal for bonding I glue 15 to 18mm ply strips from the leading edge ply to the trailing gusset on the rib caps. This gives a good bonding area also eliminates the drop in the fabric as it leaves the leading edge.

SPARS. Pick the best material you have for this part of the project, in particular the spar caps. . Purchase certified material if you doubt your ability to chose. Either that a friend who knows. Use birch ply for thr spar webs or ply of similar strength. I used Mountain Ash (Tasmanian Oak) or Silver Ash for the hardwood blocks at hinge points and where ever they are required. When you purchase a sheet of ply, if you can hold it up top a window with the sun shining on it you can mostly pick any spots that let some light through. Meaning that the middle core has bits missing.
The ply on the webs is vertical or 45 deg. As you see on the drawing the small verticals are mounted at the rib stations. You should drill a hole in these to allow an air passage.
You may consider it a hard job fitting anchor nuts inside the bottom spar cap for the cabane and pushrod pick brackets. If you look at sheet 4 of the photos you will see I added an extra vertical between the boltholes. Also extra ash blocks and using the drill jig shown on drg. 24. I then used through bolts, or they can be made from 4130 5/16" rod threaded both ends See page 113/114 The nut at one end should be put all the way on the thread. This end put at the bottom against the brackets. I will add more in front of the assembly jig.

THE RIB JIG. To save using staples or AC nails to hold gussets I in making the rib jig make a top plate that is positioned by 2 long pieces of threaded rod that are fitted to the main jig plate. Nuts and washers both sides of main plate.
When its time to fit the gussets apply glue and press the gusset down in place, when all are ready slip the top plate carefully on and clamp evenly.

RUDDER. The drawings show a one piece rudder and a fin and rudder. If you choose the one piece you will need a small version of the drill jig shown on P105 because of the taper of the fuselage. It will also help for the tail spring assembly. I used a fin and rudder for two reasons, one being I like it, and second I believe that as you apply rudder it creates a high lift airfoil. Making the turn effective. The test pilot said it was one of the fastest turning he had flown. I fitted the 'Howell' type spoiler on the front wing and thinking it would reduce the effect of the rudder I made a new rudder with about an extra sq ft of area and was told it, as he put it too twitchy. Because the rudder width is app 44mm this does not leave room to use a channel mount with an eyebolt. You can use 2 eyebolts on the fin and one on the rudder.
P95 shows another type. The reason for not using one eye bolt on the fin and rudder is that if they came loose and turned it would lock the rudder from turning. On P92 this does not apply. You may have access to some other way of doing this.
On P94 the rudder horn needs to be fitted when you are gluing in the 2 solid ribs at that position and before fitting the lower skin
The hole in the skin will give access at some future date if req.

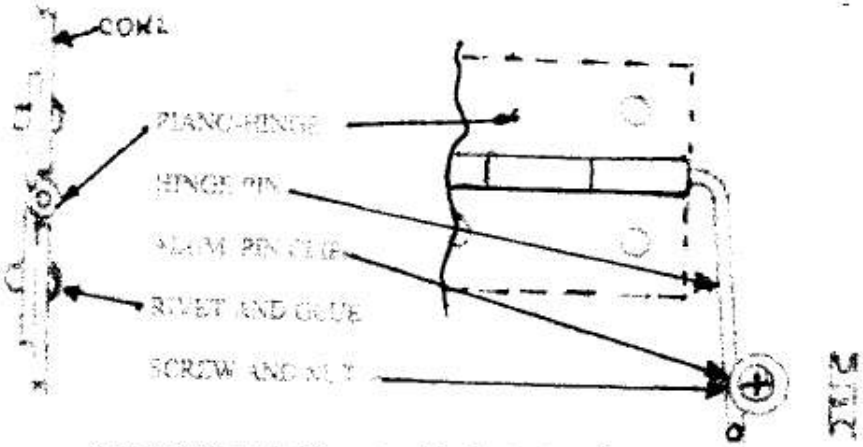
FUEL TANK. During your making of the firewall you should make a laminated bow section (ply faced) to be put on top of the firewall as part of the coaming and tank cover and leading up to the instrument panel. This cover can be made removable. For the tank I will explain how I made one. Using foam blocks app 2" (50mm) thick I bonded and carved the shape I required. Part of the tank will sit on the ply top behind the firewall bow. (Keep the size smaller to allow for the glass laminate.) Then shaped to dip down behind this platform and back to where you are leaving room for your instruments and wiring etc.
I then smoothed the shape and sealed it to a good finish. First I used epoxy then filler and paint. (Like doing ding repair on your car) By the way I made a small rounded sump section at the lowest point on the bottom so I could fit a drain tap.
During this I bonded in a pick up tube at the back of the tank. This allowed me to mount the mould on a column at waist hight so I could revolve the mould while making the tank. You say but but yes I know. Later.

The mould will be waxed and waxed, then a release agent applied (water-soluble poly. See the glass man) Now you can lay up the tank glass use fabric and bond in the tank cap spout and drain boss. Only carry the glass over the back far enough to leave an area about 8x5 inches around the mount pipe. When you are finished you can mould a flat panel that will be bonded onto the hole that will be left. You can bond in near the top layer of glass a couple of hold down straps. Now the fun bit, remove from the pipe and break out the internal foam mould. A drop of water or two will help with hard bits. And it you waxed and did the release agent correct you will have a smooth inside.
You ask what about the fuel line? This brings us back to the motor you will use. What I did (using a Rotax 503) was to bond in a aluminium line at the top of the tank rear then down, across the bottom to near the water dish area.
The end of this pipe was drilled with a lot of 1.5mm holes de burred inside then the end flattened till nearly flat. Several small layers of glass were applied at a few points to hold the tube firm. Make sure there are no loose fibres left protruding from these. The hole in the back can now be cleaned up and the flat panel bonded and pop riveted on. Make sure any cut edges are covered with you lay up resin even dip the end of the rivets in resin. I used epoxy lay up resin. It bonds to it self better than the others as you will not be able to do the job in one go.
A good thing to have is some peel ply fabric even polyester rag BUT NO COTTON ETC. Try it first. What you do is do some lay up and when you want to stop apply the cloth and smooth out with your gloves, and when dry it will peel of leaving just the pattern of the fabric and no fur sticking up. Very little sanding will be required before the next lay up.

ENGINE COWL The making of the cowl is similar to the tank. You can use any material you have, Foam, wood etc to mock up your shape. Seal paint and wax the same. You have to decide where you will split the finished job. Also you can make with the lower rear of the cowl lower than the fuselage or widen the rear of the cowl at the sides at the firewall. Lumps and bumps can be added in the mould. Lay up to suit the same as the tank but be a little more neat to keep as smooth a surface as possible. As to finish it you can use a made up putty of resin and Q cells or micro balloons. This is easy to sand to obtain a good finish.

One way of joining the halves is to fit piano hinge as shown in the sketch. The finished cowl can be cut with a fine blade saw, like the back facing teeth on some small saws. I have even added a radius in the corner using just the point. Rivet and bond the hinge halves. You will need to add extra inside at cut points, or holes and at the rear where it is screwed to the firewall. small mounting brackets can be put on the firewall, using anchor nuts or cam locks etc.

A COWL JOINING METHOD.



I used a full cowl with a cut out in the top to gain access to the motor, and a lower exit for the air. But next use a nose bowl piece. Fit side rails and have the top sides and bottom made from flat sheet of metal or GRP with simple bends to suit. Also the exhaust outlet will be let into the bottom. If using a 503 a hole will be required for the air cleaner.

I WILL COVER DETAIL OF THE ENGINE MOUNT AT THE DRAWING .

HERE IS A SKETCH OF THE RIB CAP BENDING JIG.
You can make a few of there they don't take long to make, that way you can save time waiting for them to dry. I usually leave them at least three to four days.

SOME ADDITIONAL NOTES.

P 56 : If you use the ply top on the fuselage as the 293 version (This seems to be the main difference between the 2 models. Then of course is motor size, wing position etc) Now when using the ply top with holes, cover these with fabric or some method to keep water and dirt out.

P 57 .If you use the square sides fuselage the Frame 3 will need an adjustment to the hight.. Frame 2 can be fitted with temporary verticals You can use a thin strip of timber between frame 1- 3 and stern post to establish the position of frame 2.

P 60 , If you want to use rudder pedals or bar you could also use a side stick. This will make getting in and out of the Flea easier. The cables for the rudder can be passed through alum tubes (6mm) along the fuse sides and through the No 3 Frame, the locker and fuse sides keeping them as straight as possible.
Keep in mind Item B there is a note to see Dwg 4. The 2 -51/16" at the bottom of the UC fitting may need to be set deeper down to align with the fittings under frame 2 they must line up.(A rod to pass through all) Otherwise the Under carriage will not move up and down correctly.

P 63 You won't know initially where the front wing will be positioned until you are as good as finished. So to mount the wing to establish CofG use a temporary rear cabane tube made from any tube even add a nut and threaded rod to adjust.

P 91 Fit flat washers at the top and bottom of the rear wing spacer tubes. They can be silver to the tube (but remember the lower one is at an angle)

P 107 You can use 25mm wide tie down straps to hold the leading down while glue sets. Do not over tighten these. Place around the rear spar next to the rib. DO NOT USE THE TYPE WITH THE RATCHET LOCK. You can also use rubber bands made from big diameter inner tubes. On the under side of the D nose skin you may need to use tacking strips or slip pieces of packers under the straps to keep the ply against the rib.
Please do a dry run when doing this work, because when the glue is spread its too late to change your mind. This applies to all jobs. REMEMBER MEASURE TWICE AND CUT ONCE.

P 97 The mount tube position depends on the motor, tank and cowling hight. adjust up and down to suit.

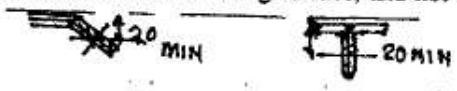
P 62 Be careful when laying out the bolt holes for the brackets so one does not interfere with others. Or you may have trouble getting the nuts on. Also the strut strap fitting can be squeezed in if you are using the flat strap type strut. That is reducing the 8mm dimension.

P 81-88 3There have been a lot of opinions as to the need for the "Cossandey" flap; it does add weight at the rear, which no one needs.
They say that if the CofG is correct it is not needed. During the testing that was carried out on the one I made the test pilot said that at no time did he need it during any manoeuvre. He used it sometimes as a trim during take off and landing.

P 84 Where I have shown in note A the holes at an angle, avoid this by sloping the ash blocks at the top of the spar. This is shown on another Drg.

P 106 Although I show springs in the cable ends they need to be vary strong, or if pedals are used eliminate them. They were only used to take up the change in length caused by the tail spring arc. It was found that in a crosswind landing the side force used up the steering.

P 85 The bent welded strut and cabane fittings on the front wing need to be the same distance from the wing surface, and not less than 20mm

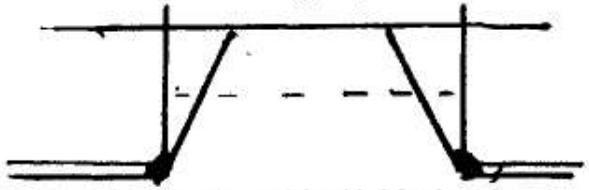


P 98 The rubbers shown are from an auto shop. They are used in sway bars etc.

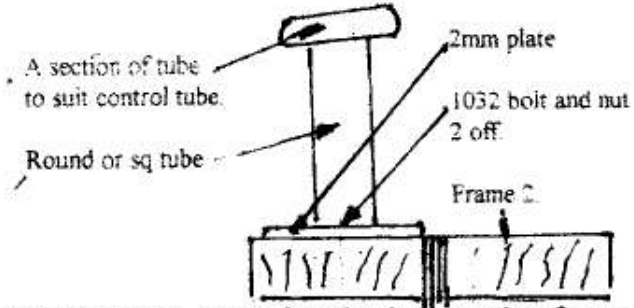
DO try to get or purchase copies of books like the E.A.A. magazines and how to do it books. Talk to other builder's etc.

P 17 If you decide to fit the head cut out in the rear of the front wing you must decide which type. It all depends on the wing position. One thing I hate is not being able to see as you turn corners. All high wings have this problem. The round type is hard to get the fabric to take up the correct shape.

Cont, P 74 You may like to use the straight faced with sloping sides. This will make fabric covering simpler.



CONTROL'S. If you use the straight-sided fuselage the cross tube will have to be lengthened. Also add small oil holes. A pillar stop is in my opinion required to prevent the wing from going past zero deg, with the stick full fwd. Leave till you have finished the AC. Attach to the 30mm cross member of frame 2. Slope the top to suit the control column tube.



THE WIND SCREEN. A way of keeping the lower edge of your screen straight is to use a thin piece of timber and bend it over the coaming. Hold at the end with clips or small nails. I then make a mixture of epoxy with Q cells (or micro balloons) to a putty constancy. This is put in to the back of the timber (the triangular space) This will be Ok to attach the screen with small screws and washers. Make the screw holes a bit larger to help eliminate screen cracks. Even put thin rubber washers between the metal washer aid the plastic.
Use a rubber or plastic U channel around the top.

A fill in faring can use the same channel under the rear wing . Use 1.5mm ply for the fairing.

The floor under the seat con be screwed in with small screws and glue. Or if you wish to sit lower. a metal insert can be used.
A hand hole can be made as well.

The luggage locker floor be extended to the lower side 30x15mm longerons. then fit the push rod tube (if the flap is used) through to the locker back and mount the crank arrangement on the back. Use only push rods for the flap, as I am not sure if flutter could eventuate using push pull cables.

GLUE. I use a two-pack epoxy. Check with the manufacturers information to see if suitable. Try not to use in temperatures below 20deg or above 70% humidity. Again check with the supplier.

You will notice from the photos that there is a different centre section. the first one was damaged in a bad cross wind take off. Ran in a ditch. Some sneaky (Sod) person hid it under a bush. So I decided to update it by using girder type ribs. Carried the leading edge ply back just past the spar and added 6x6mm edge under the ply to prevent buckling. I included a version of the HM360/380 hinge so I could use short bolts. The full length ones are impossible to get here. The girder type ribs use less ply (and Money).

POINTS TO PONDER.

Measure twice and cut once.

When you do a job, what's next? Will it fit?

For metal fittings, check where they are to go to see if the boltholes will go through the centre of the timber member.

Paper, plastic or light metal templates are cheaper than expensive metal.

Study the Drawings till you are familiar with all aspects of job to do.

CENTRE OF GRAVITY. It can be established by using the pivot method, or scales and measurement's. (RG 22.) The measurement method means to establish the pilot position in the calculations. A close way is to sit the pilot in the seat and check the distance to his belt buckle. This is a rule of thumb way.

When you check and find OH! OH! its too far back this means (YES) the front wing has to be moved back. Yes I know it sounds stupid. But it drove me mad till I accepted it. That is why I said make the rear tube of the cabane adjustable.

Don't forget that on the engine mount [P 56 said its position is used in establishing the CofG..

What it actually means is as you build you can do spot checks for establishing your CofG by using any weights to hang on or sit on where bits will go. Even to weigh you rear wing and put on a roller to find the CofG then you can put a weight on the fuselage in its place.

A LITTLE MORE on CofG. I found as I said the roller is a difficult way of doing it. If you wish to try and have lots of help. Make the platform and a low saw horse. Then you can raise the tail, slip the saw horse under, bring the tail down to where the top longeron is level. If you have already established where the CoG should be by measuring the distance from the LE of the front wing to the TE of the rear wing and divide by 4. Now remember it is best to have the pilot, fuel and all fixed equipment on board. You will find out which way to adjust the front wing. I would have done this exercise before permanently fixing the motor final position. I left the EM bearers longer so I could do this. I had to make an estimate of the cowl weight to add at its approximate centre. It does get a bit fiddley at this point (and maybe a bit frustrating) you are aiming for 25% at this time. You can add or subtract fuel, Add extra weight at the pilot belt buckle point. This way you can find what it takes to reach the forward 23% or the rear 27%.

CANOPY. This is something I would not use. The reason some canopies can be a problem. There have been a couple of instances where they have opened in flight. Not good. A side lifting door jammed the front wing on a 2 seater with fatal results. And I hear a up lifting to the rear did the same. Maybe locking was at fault. Rear sliding canopies don't have this problem. I have built AC that had them and they only wanted to shut. (The lift bubble??).

A strange thing, the test pilot said that when you took off there was very little wind in the cockpit. He gave up using goggles and just used his sun glasses.

Lets look at P 125 119. To conserve space in the locker, you could move the flap leaver pivot forward of frame 3 and add a push rod to take reach behind the locker. Items 9 etc can be mounted on the rear of the locker wall. A simple cover could then be fitted so as not to be interfered with by your luggage.

Remember that if you are careful you could leave say the LH SIDE ply off the fuselage while fitting out .You will have to splice the ply any way, so fit the back part.

THE TRAILING EDGE.

This is a minor part of your wing. But they're a few different ways of doing this. For this exercise I will use the TE of the HM 293 Pou De Ciel. It measures 24x12mm. In the raw state. Fig 1

The sketches will show the grain direction and detailed dimensions. For a straight section of wing it is just cutting to size. If you have a saw bench that the blade can be tilted, great, you can cut the angle required to give you the taper. But if like me I don't have that means, so I either plane it on the bench or mostly fit it as a rectangular piece as shown in Fig 2. As I have already glued on the lower gusset the TE will sit in place. Now the tricky bit. You can plane it to size, but you have to be very careful as you may hit the rib and damage it. I overcome this by altering the leading edge and corner of my plane. This is a good idea for any clean up work you have to do in your construction.

What I do mainly is to use a 100mm-angle grinder with a flexible sanding disc, and by holding it at the right angle use it like a plane. (That is the best way I can describe it) and very carefully remove the excess timber. When you get to a point close to finished you can plane or use a sanding board. The disc you use can be rather course.

You can then add the other gusset. There are a few types of gussets that are suitable.

Curved trailing edges are best laminated. I have found no other way of doing it. Use strips say 12x6mm or and scraps you have left from other cutting operations. As in the folding wing tip of the Flea I glue, and with one thin brad (tack) use it to hold one piece the the shaped end of the rib. When dry repeat this with enough bits to make the desired thickness. Then clean up as before. By the way use clamps, pegs or bit of split plastic tube to hold in place as you laminate. Fig 3.

You will notice that I show the 3mm TE to be left square. I also when fitting the wing covering iron the fabric and tape the same. It may only be a little thing, but Read somewhere that a round edge only helps in the airflow to coming from the underside to the top causing turbulence thus drag. I have no Idea if this is worth the trouble, but as the monkey said ever little helps.

It pays to taper the gusset for about the rear third as a fat edge looks lousy, anyhow the fabric will fit better. You know the old saying neatness counts you don't want people thinking you are an amateur, do you.

FINISHING. I know it is usual to finish the aircraft with at least a dope system on the fabric area. But these days some are using a two pack finish, to get a nice shine. I do not agree, one thing is it is hard to repair thing to do is use a system recommended by the paint Co.

But I have read of a system where you fit the fabric in the normal way up to the first coat of dope after you have bonded and stretched it. then apply one coat of dope to seal the fabric. After this apply 2 coats of flat black Acrylic exterior house paint. Them apply your colour in exterior weather shield type house paint.. It may not shine as well as two pack, but a lot cheaper. Think about it, it sits on your house in all weather and lasts up to ten or more years. You are not going to leave your Flea out in the open are you??.

The fuselage can be done in any type you like as it is ply basically. Things like UC legs etc can be done in silver, But note that a coat of top coat clear gives silver a nice finish. Like the wife's car.

WHEELS. I used 5" with 5" tyres. Look for the continues pattern. Not like the car type as they can throw stones. Does not help the fabric

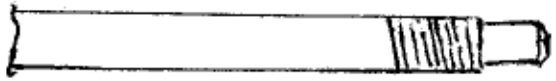
SPAR TEST. You will see in the test photo a test piece showing a section of spar using the HM360/380 type hinge. The timber, ply, and metal used in this test were not good quality. The reason being I wanted to go for the lowest results possible. The bricks you see are a load only part way. There were more added to the required figures, and I also stood on the end of the beam. But before I could pick up the camera the lot fell over.(The inspector had gone to lunch)

SPOILERS. The photo's show a copy of Phillip Howell's effort he has on his HM293. I had to change a few things to suit material available here. But basically the same. The idea is to help in cross wind landing's. You could contact Phillip and I am sure he would sell you a copy of his drg's.

SPLICING. timber splices are best done with the both halves side by side. Cut off most of the waste with a saw, clamp both pieces side together and use a sharp plane to finish.

PLY you can do the same. I have used a drum sander or even a bastard file. Keep an eye on the laminations as they will guide you.

Wing bolts. To help to make these bolts from steel rod, first cut the rod oversize by approximately 16 mm. the reason for this is to be able to machine 8mm down to the root diameter of the thread. Why you ask, well it is so easy to allow the thread to run off during the threading operation if using a die to cut the thread. When turning this you can use the die to gauge the diameter. The pilot piece is cut off after threading. This method can be used if you make your own eye bolts for the rudder.



BOLTS, A point to note. When fitting bolts always remember that when they pass through fittings, you need plain shank passing through the metal to carry shear loads. But if it goes through wood after the metal, then a washer, which is there to stop crushing loads only. Thread then is not a factor. If another fitting use up to 2 washers can be used to cover any plain shank that shows or use the next length smaller.

FUEL TANK. If you use a tank as shown on the drawing some of it may be seen below the instrument panel, This if clear or opaque can be marked to show fuel quantity. Say on the left side tail down and on the right when fuselage level as in cruise position. Add fuel a litre or 2 at a time and mark.

A fuel gauge can also be made to cover the higher levels. Because you will fit the filler neck near the front of the tank. NEAR the back and you may get sprayed during climb through the cap vent..

A float can be made by using a piece of 1.5mm stainless welding wire bent at one end to a small "U" then poked through a piece of cork fishing Float (line reel). The U is pushed in the end, (it pays to cut a shallow slot for the end of the U.) This will stop the wire from making a grove in the tank. (a small thing ,but small things can cause trouble) NOT Confucius, Me. This then is fitted through the tank cap and fit a small knob on top (super glue). There is no real need to mark the wire as up is full and when it stops dropping you look UNDER the Panel. Adjust the wire so when the float hits the tank bottom there is just the knob showing as the float will be sitting on the tank section above the cross ply on the fuselage top behind the firewall.

PROPELLERS. This is where I ran into problems. It happened top me in 1959 when fitting a new prop to a new AC. What was supposed to work, did not. I borrowed props to try on ground runs, but most available were pusher props , no good on a tractor plane. I managed to get a 60" one that had been attacked by an angry disc sander or something. I cleaned it up, balanced it. Also purchased a 60" one for a different Gear ratio. This prop reved out to high. So what to do, I as before believed props are "very strange beasts". I made a prop carving machine, the type that uses ply and hinges and a router. I tipped the wrong pitch one up a bit on one side, and used it to make a half prop pattern. Glued a Ash blank and made a prop. It worked. The attacked one also worked, but as the airfoil was an unknown quantity the rev's were a bit different but within the motors specs. I have since read Al Schuberts book titled HOW I MAKE WOOD PROPELLERS. I will in future use his system. It is worth asking around to find a copy to study. If you decide to play this way be careful how you go. This was my first attempt. What I did find that when i had routed it out, still in a rough condition. Needed filing and sanding, I could not wait so put it on the knife edges and it actually balanced.

MOTOR. Depending which you one you use you will need to tip the thrust line down by about 3 deg to the longeron line. Also about the same to one side to counteract the prop push to one side. Your prop rotation will govern this. A trim tab on the rudder will adjust any small differences. A good idea is that when making your motor installation to make allowances for packers under the mount rubbers for fine-tuning. Also watch your cowl opening is not too fine.

NOTE !. I have stated elsewhere that the wing gap can be up to 500mm but recent thinking is it then becomes a tandem wing AC and the down flow to control lift on the rear wing could be lost or down graded. This Flea has 70mm overlap and has shown no problems.

Just remember that the rest position of the front wing when folding the rear wing after you have finished flying for the day.

19.
MATERIALS & HARDWARE.

Steel sheet. Although the original Flea drawings called for mild steel sheet it would be best to use 4130 for important fittings.

Bolts. The **AN** series are used. Diameter's are quoted as-3 =1032. - 4 =1/4". -5 = 5/16". -6 = 3/8". It is best that you consult a suppliers catalog. for lengths.

Nuts. Nyloc type are AN365. Castle type are AN310. or a AN363 all metal for use in a heat situation.

Anchor nuts. use AN366F or MK1000. there are many other types.

Washers. An960 used with metal fittings OR AN970 used with wood contact.

Tubing. 4130 steel is the general type used. Unless called for otherwise.

Timber. Spruce is the most popular but as it is hard to get in some places, there are some alternative's. Hoop pine. Hemloc. Douglas fir. Baltic Pine. There is an Australian Gum called Rose Gum or Flooded gum grown in South Africa that is being used. Stronger but a weight penalty.

Eye bolts. AN42B or AN43B can be used for the rudder hinges. **BUT** you must use 3 per hinge. Use 2 in the fin and one in the rudder. As they have a round washer built in the 2 must be spaced to fit side by side. An970 washers behind the spar or a metal plate made by you. The gap between the blades will be larger than the single eye bolt in the rudder. Use spacer washers or tubes to take up the slack.

Throttle. On the seventh photo sheet you will see (LH side) a small photo of my throttle, made from 3mm aly, and using plywood washers as the friction medium. The bolt it is mounted on id welded to the mount bracket. The tighter the nut the more friction (sounds logic, eh) The cable is a push bike brake cable. The end in the Bing carb, needs a little surgery to go in the right place. your end goes through a adjuster mounted forward to the throttle. Then I wrap it around a little ferrel like the one shown on page 14 and using a 1/16" nicopress clamp it. I had to fit an extension as you see it worked great. "Necessity is the mother of------".

Exhaust. The muffler I had I fitted across the back of the motor. To accommodate it I welded a channel (or tube) between the Mount rails and used silicon rubber discs to help with vibration. (the white food grade rubber) As you see it goes into the cowl by just below the joint, and out the same. The hinge joint in the cowl is just above the exhaust.

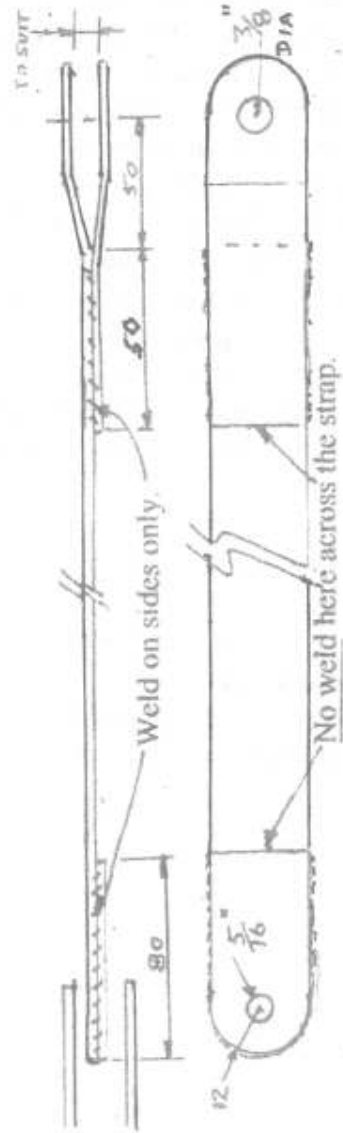
Spoilers. Should you wish to fit these for cross wind help and approach Phillip Howel to buy a set of drg's and electric info,. you could make provision to set in the wing at an early stage of manufacture by adding doublers in the rib caps to accommodate them.

Follow up. I intend to do this if plan purchases give the plan set or CD No. and E mail address.

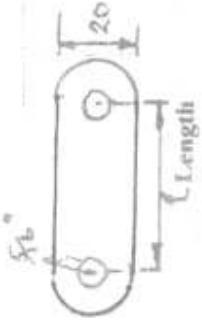
I am building another Flea version and when finished in the future i may find some ideas. Basically the same AC.

ADDITION TO DRG, 14

This id the strut strap I used. It is made from 4130 steel. Note there is no welds across the width. Only around one end.The small connecting plates fit at the fuselage end. The length is decided at rigging. Minium, length is 1.5". Apply 15lb load on wing tip while working out the length required.



Connecting plate and strut strap make from .083" or .090" 4130 steel. Rolling marks lengthwise.



LENGTH MIN 40mm.

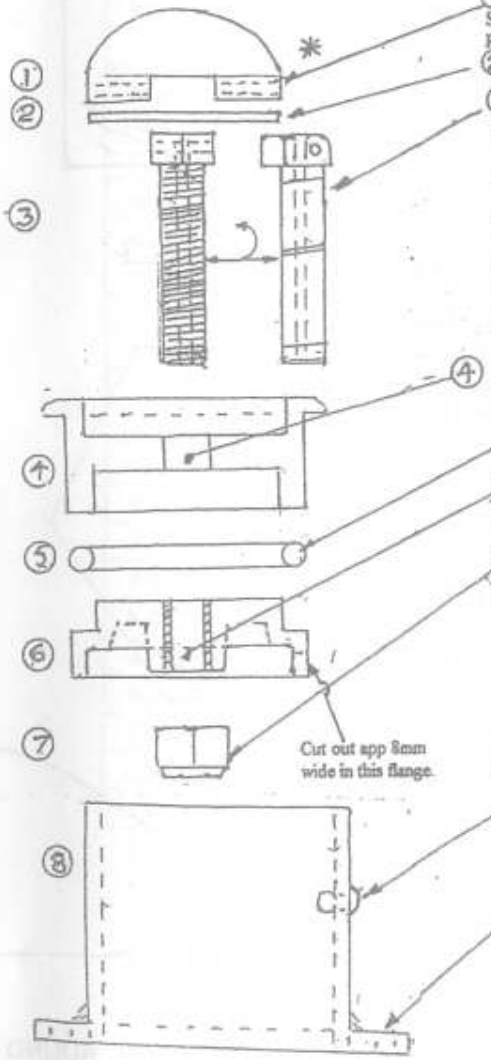
A TUBE STRUT END AS USED ON HM360 I USED THIS ON A HM14.

This one shown is for the HM14 as it had a ¾" tube so it is fitted inside. With a 5/8" tube it fits outside, see Other drawing.

A FUEL TANK CAP.

THIS IS A TANK CAP I HAVE USED; IT SERVES 2 PURPOSES, AS WELL AS A CAP IT CAN ACCOMMODATE THE FLOAT TYPE FUEL GAUGE. MAKE FROM ALUMINIUM BAR.

1 SHOWS A HALF SECTION VIEW. DIMENSIONS CAN BE SCALED OFF THE DRG, EXCEPT DIAMETERS, WHICH WILL BE DETERMINED BY THE TUBE SIZE OF THE FILLER NECK.



(1) MAKE FROM MS 20001-2 PIANO HINGE OR SIMILAR. THE CURVE TO SUIT THE CAP TOP RECESS

(2) HINGE PIN.

(3) ST. STEEL BOLT. MODIFY HEAD AS SHOWN. CUT OFF 2 SIDES TO FIT IN THE HINGE GAP. AND ONE POINT TO ALLOW FOR THE HINGE PIN TO BE DRILLED TO CLEAR THE FLOAT WIRE HOLE IN THE CENTRE. ROUND OFF THE TOP CORNER SO HINGE CAN STAND UP. THE CENTRE HOLE FOR THE FLOAT WIRE NEEDS SOME CLEARANCE TO ALLOW AIR TO ENTER THE TANK. SAY 1.5mm WIRE 2.5 mm HOLE.

(4) DRILL 3/8" OR 10MM TO SUIT ITEM 7 WHICH IS A 3/8"WIT OR 10MM ST STEEL BOLT.

(5) A "O" RING ABOUT 4mm DIA, O.D.TO SUIT I.D OF THE FILLER-NECK.

(6) TAP CENTRE TO SUIT THE BOLT. THIS DIMENSION TO SUIT THE "O" RING CAN BE RELIEVED TO SAVE A FEW GRAMS

(7) NUT TO SUIT BOLT.

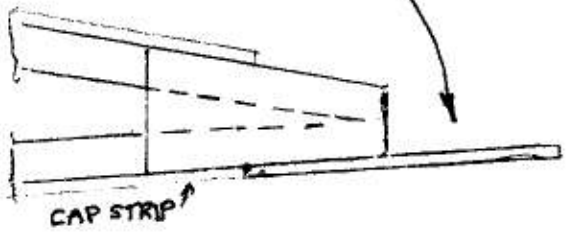
(8) FILLER NECK CAN BE MACHINED FROM SOLID OR TUBE WITH A PLATE WELDED ON POSITION THIS 1/8" POP RIVET TO SUIT THE CUT OUT IN ITEM 3 . THIS WILL STOP THE CAP ROTATING IF WET WITH FUEL.

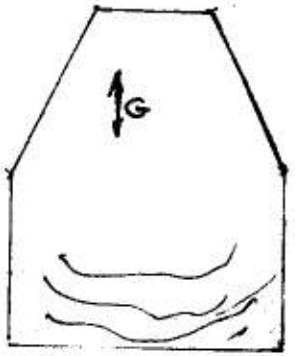
IF THE FILLER NECK IS TO BE ATTACHED TO A G.R.P. TANK DRILL SOME HOLES AROUND THE FLANGE. THE FLANGE CAN BE CUT FROM A SQUARE PIECE OF ALUM, IT IS A GOOD IDEA TO FIT THE FILLER TOWARDS THE FRONT OF THE TANK TO PREVENT SPILLING IN A CLIMB ATTITUDE.

THE CAP OPERATES THAT WHEN

FIG 1.

FIG 2.





GUSSET'S

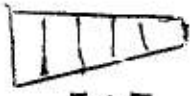
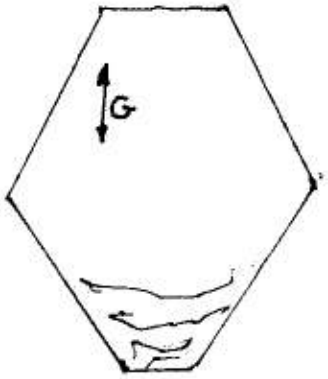
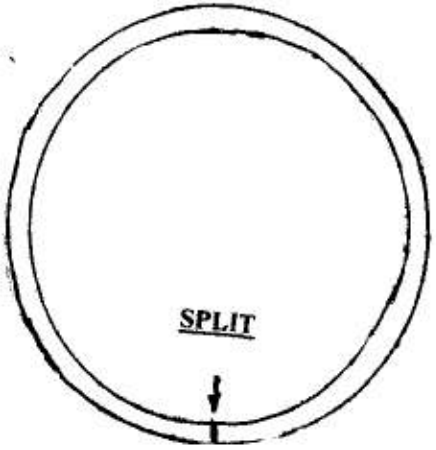


FIG 3





50mm PLASTIC DOWN PIPE

HAND PLANE. ROUND OF THE LEADING EDGE AND CORNER.

MIGNET 34.0.13 AIRFOIL.

Coordinates are in % cord

(Do not round these numbers off while multiplying by Cord Length)

This Chart Done by Richard Fraser.

STATION	(+)ABOVE CHORD	(-)BELOW CHORD
0.000000	0.012864	0.000000
0.003125	0.020201	0.005111
0.006250	0.024724	0.008015
0.012500	0.031321	0.011477
0.025000	0.041659	0.014652
0.037500	0.049914	0.016783
0.050000	0.056902	0.018514
0.075000	0.068453	0.021412
0.010000	0.077628	0.024001
0.150000	0.089597	0.028951
0.200000	0.095835	0.032317
0.250000	0.097426	0.035017
0.300000	0.095712	0.036916
0.400000	0.086890	0.038477
0.500000	0.074416	0.039620
0.600000	0.060366	0.038214
0.700000	0.046001	0.034226
0.800000	0.031151	0.028225
0.900000	0.015770	0.018686
0.950000	0.008062	0.011771
1.000000	0.000000	0.000000

L.E. Radius 0.015385
Station 0.014437
(+) Above Chord 0.005315

NOTE The leading radius shown is for reference only. There are enough points given in that area for a smooth curve.

SEE PAGE 140

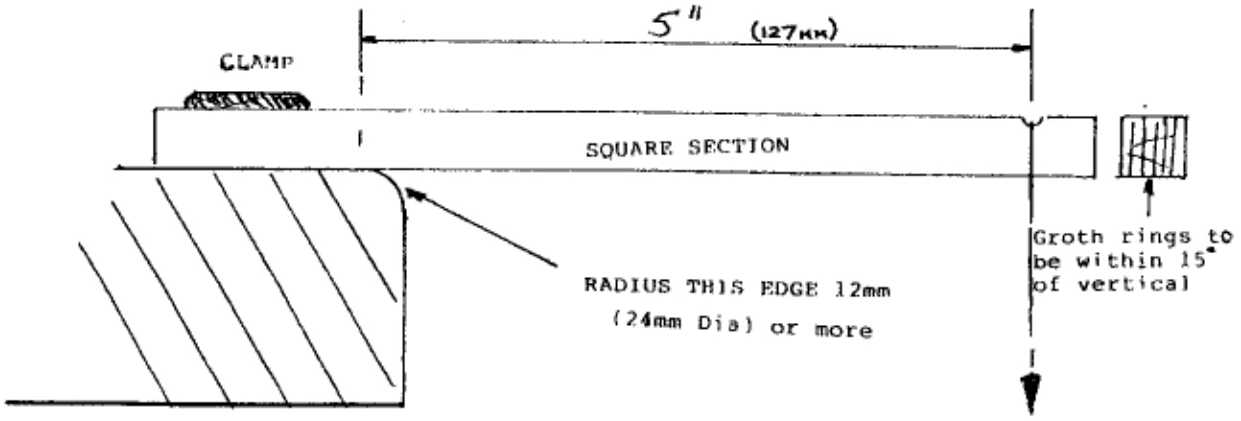
A GUIDE TO TIMBER SELECTION AND TESTING

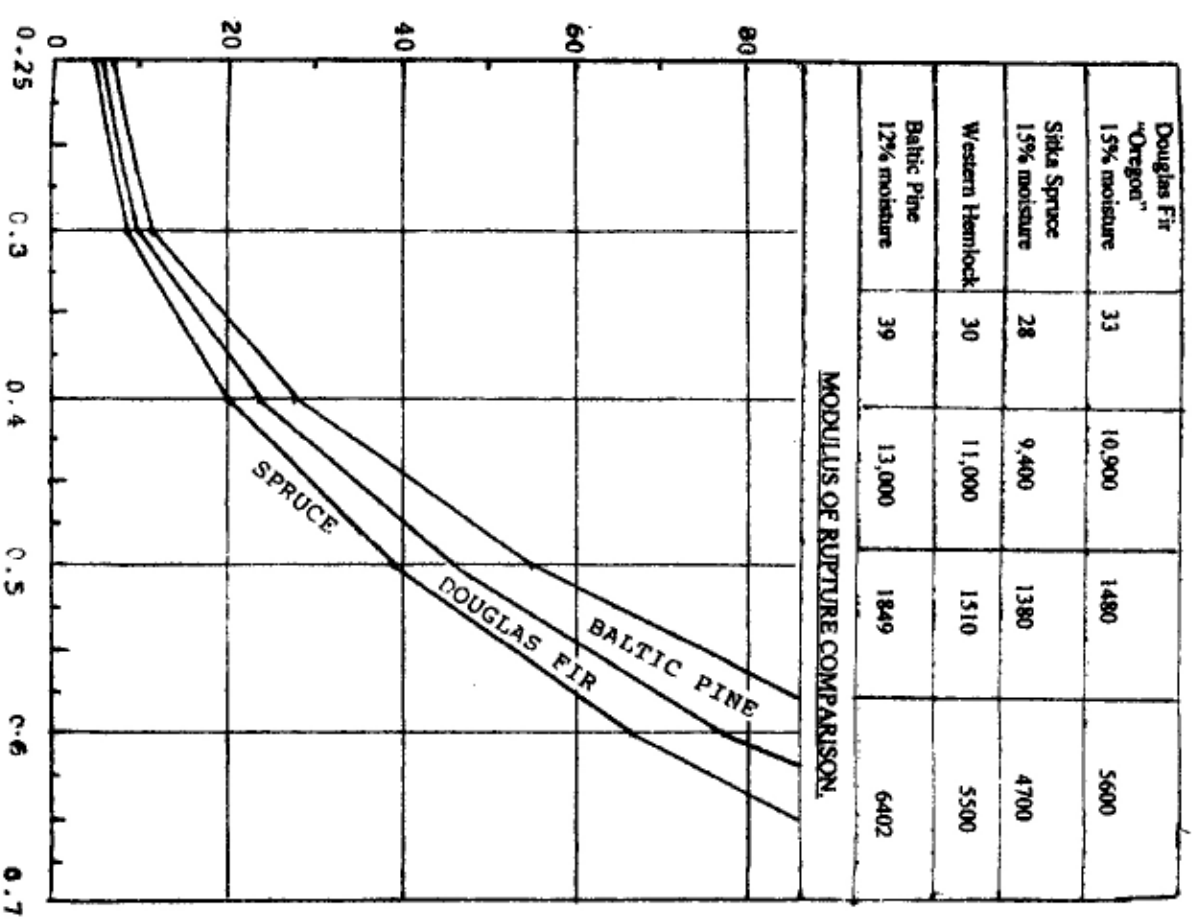
TEST PROCEDURE.

(A) Prepare a piece of timber 7" or more of square timber .250" to .7" being square is Important.
(B) Clamp the sample to a radiused block as shown below. The growth rings to be vertical within 15 deg.
(C) Apply the load slowly till failure occurs. Load to be applied at the 5" point. (See below)

(D) Locate your breaking load on the left of the graph. Find your test piece size on the bottom, These two points should meet to the LEFT of the curve for the timber selected. If they do the test sample is OK. To the right of the curve is a failure.
NOTE! .375" is a good size to use. Then an 18 to 20 lb load can be kept for use to hang on the sample. Apply the load slowly, not in a sudden way.

OTHER FACTORS. Moisture content. Timber density. Acceptable no of growth rings. Defects splits, knots, pockets etc. Slope of the grain.





MODULUS OF RUPTURE COMPARISON.

TIMBER SPECIES VALUES TAKEN FROM ANC18

SPECIES	DENSITY lbs ft 3	MOD OF RUPTURE lbs sq in	MOD OF ELASTICITY lbs sq in * 10³	COMPRESSION STRENGTH lbs sq inch
Douglas Fir "Oregon" 15% moisture	33	10,900	1480	5600
Sitka Spruce 15% moisture	28	9,400	1380	4700
Western Hemlock	30	11,000	1510	5500
Baltic Pine 12% moisture	39	13,000	1849	6402

ADDITIONAL NOTES ON RIBS.

These may be things you know, but revision is sometimes OK. It is needed to keep the outer surfaces of the spar clear of obstructions. Such as bolt blocks or ply doublers to fit the ribs. This brings us to the rib construction; you can make with all vertical and diagonal members, or leave out the one behind the spar. It is very hard to expect the width of the spar to be like a machined piece of metal. The timber and ply can and will vary by a small amount. I mean the thickness of a piece of paper is enough to make it difficult or impossible to slide the ribs on to the spar. Now if the vertical member in front of the spar is positioned in the jig tight against a jig block, using wedges or a cam disc, the rib can be assembled quickly glued to the front face of the spar and later add the rear vertical and its gussets. Another way is to add say one or 1.5 mm gap to the spar opening at the fear face, complete the rib and it will slide on simply then slip in a suitable strip of timber to fill the slot that will be there. This method may give you a problem if your jig is not substantial. You will find the trailing edge of the ribs may not be in a straight line. You may even have to do a bit of careful filing in the gap of the rib to align these. It may even be required when all are assembled to add thin slivers of timber to either the top or bottom or the nose section to keep a straight line for the ply leading edge. Again it pays to fit one of the trailing edge gussets so you have a place to put the TE strip on; this makes it simpler to shape the TE. See the note on Construction Note 15 about planes. I have used an angle grinder with a flexible disc to remove excess timber to make the wedge shape. PRACTICE FIRST.

I am asked many questions at times so I will try to answer some of them about ribs.

The nose blocks are one. If you do not have equipment to make the curved shape. Consider that the shape and size is to do 2 things. One to fit the LE strip. 2 give enough area to attach the top and bottom cap strips and gusset's, If you have pre bent them in the jig shown elsewhere you can use a shape to suit your means. I sudjest a rib jig that will always reproduce the same shape, a few nails is a NO NO to have each one the same.

When gluing on the gussets apply the glue to the rib and apply the gussets and leave stand for some minutes, them press down with care, as you will find they may want to slide to one side. This will squeeze out the excess glue, then be careful as you put on the pressure plate and clamps. What is this you say. It saves using staples or nails, which can split the timber and give a lot of extra work. I obtain from a kitchen cupboard maker off cuts of white faced pine board to make jigs.

Remember you will need a template to mark the nose shape after the glue is dry and show where the cut out is for the LE strip.

A few more notes on a variety of things. The fuel tank cap arrangement shown on Note 13 .CD or drg set no The alum, used is what is called machining grade. Soft alum, bar is too easily damaged. I have made these and similar out of what is called alum, tooling plate. 2011 -

Under carriage. You will see at the position where the axle goes in, I have put short tubes inside the tube to be welded rather fit a thick tube this helps to stop weld penetration making it hard to fit the axle. There in not many things worse than trying to remove weld from the inside of a tube. Drills jams– reamers break, etc. Don't forget the alignment of the fittings on the fuselage.

REMEMBER to break the glaze on ply and timber when you are ready to glue. And be careful to vacuum the surface clear of all dust.

On the fuselage and wings do not do things the hard way when trying to keep things in place and still when assembling. By all means use thin bits if wood off cuts, and glue with a minimal dob of glue at an angle. (this forms a triangle very stiff) Then when you have glued whatever in place they can be removed. Great for keeping the rib ends where you want them and fitting the trailing edge (and rear spar).Just be careful when removing the. Good idea to cut either side of the rib etc then peel off with a sharp chisel, and remove excess glue.

"Cossandey" flap. I would move the item 9 on P125 **to behind the locker, leaving clear space in the middle and mount the bearing blocks vertical.**

Fabric Covering. Remember apply the poly the type bonding agent onto the wood surface ,do not be mean with it. You can use dope slightly thinned with Acetone or thinners torub through the fabric to set it into the poly. Add more coats of dope and your tape after tightening the fabric. As I will have your name and E mail address I can send any changes etc to you. Please with any inquires mention the CD or drg set No. Example on the subject line say—(Flea CD no 6 or what ever) I do dump a lot of E mails that I cannot recognise.

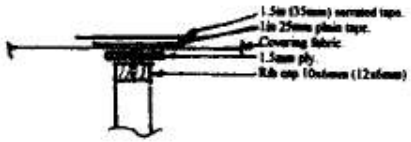
CARRY ON BUILDING. Fred

POINTS ON FABRIC BONDING.

Pardon me if I put my 10 cents worth in on the subject of fabric bonding.
In 1959 I was building Piel
"Emeraude" aircraft, but first let me say that
during the 39/45 war I worked as a teenager at Sydney's Mascot airport
on the overhaul of Avro Ansons, Airspeed Oxfords, and I became fed up
with rib and trailing stitching. back to 1959 as around that time also working
on sailplanes. I was determined to give bonding a good look. I approached
DCA on the subject and was told if I would make up a test rig they would look
at the results, Now in those days we used Irish Linen and Nitrate dope. The
test rig consisted of a 2 bay rib box, sealed and a glass tube at what would
be the front of the bay (at the rear of the spar). the ribs being used had 12 x6mm
caps, The dope was applied to the caps in many coats (no poly tac then) till
an obvious build up was seen, The fabric was then applied and with dope
rubbed in to complete the bond. A tapes was applied as normal. Let me say
here that a tape is needed for the transition from solid to flexible. This helps
prevent cracking at the rib side. The normal paint (stretching job). Linen
remember.
Two members of the department came to watch the test. We filled the box
with water and then till it went up the tube. As this happened the fabric bubbled
up. They had already decided what column of water would be a safe factor. I
do not have a copy of the results, but from memory it went to a safety factor of
about 10 before it lifted from the ribs. A big bubble.
I used the system on the Flea built in 1994 using 1.9oz ceconite and the non
stretch dope . But I did fit small PK and small washers in the center ribs, in the
prop blast area of the front wing, at app 70mm spacing back to the rear spar
area on the top of the wing.
In conclusion I do not know what the bonding comparison between linen and
poly, material is, nor the dopes of today. The rib on the Emeraude were 12mm
I used 15 ply caps on the Flea but recommend 20mm. In the finish its your choice.
Also the center section of the front wing has been replaced with an updated
section.
This includes the LE ply back to the rear of the spar, and girder ribs. Also a part
update on the folding hinge's.
One thing you will find with modern fabric that it will not stick with epoxy, or on
epoxy. It makes great peel ply in GRP layups. So do not waste your scraps.
Applied over wet lay up it keeps the bits that stick up under control.

AN ALTERNATE TO RIB STITCHING.

This I have used, whether only in prop blast area or all ribs is your choice.



The purpose of this is to bond the fabric and add screws and washers spaced from the spar rear. That is behind the D nose ply. The spacing from CAM 18 and for 100 MPH would be 70 to 100mm depending how close to the spar and prop blast area. Start the first 70mm behind the spar and go from there. Can be varied as you go towards the TE. I only went as far as the rear spar. Now the screws and washers. the washers should be Alum, or stainless steel it will depend on where you are and availability. Approx, 10mm dia min. I have a Roper Whitney Inc punch set, so can punch out of alum, the outside dia. The punch leaves a center punch mark in the middle. Then with a smaller size I punch out the screw hole.
The screw of SS I recommend, either CS or flat pan head. 4 or 6 G. Drill a 1.5 mm hole through all but the serrated tape, this is to prevent splitting the cap strip.

1. First the ply shown is glued to the rib cap. Behind the D nose ply to the TE gusset.
2. Apply enough dope to the ply to bond fabric. (Poly Tac or what is your choice)
3. done by rubbing dope through the fabric.
4. Add 1in tape doped on. As far as you intend putting screws.
5. now drill 1.5 mm hole and put in the screw and washer.
6. Apply the 1.5in serrated tape.
7. This in my opinion is only needed on the upper surface.

You will find that the plain tape over the fabric, its purpose is to prevent tearing of the main fabric when stitching. It also serves an additional purpose of creating a transition with the serrated tape to stiffen the pull of the fabric as it balloons up in flight. it also helps to prevent paint cracks developing at the ribs edge.

DETAILS OF A TEST I CARRIED OUT. ON A MOCK UP OF A HINGE SET AND A LOAD TEST ON A FRONT WING OF A HM-14 FRONT WING MADE TO THE HM-290/3 WING DRAWINGS.

THIS TEST WAS CARRIED OUT ON A SAMPLE OF THE HINGE SET UP BASED ON THE HM-360/80 FOLDING HINGE.
ALL WOOD AND METAL PARTS WERE OF INFERIOR MATERIAL AND NOT GOOD WORK PRACTICES.
I CONSULTED AN AERO DESIGN ENGINEER WHO ALSO TAUGHT AT A UNIVERSITY TO OBTAIN THE LOAD LAYUP.

THE TEST POLE WEIGHED 11KG (24.2lb) CONSISTING OF A SHORT SECTION OF SPAR MADE TO MY DRG, 27-28 LENGTH 2.6m (8'7") = 2.85lb ft. ATTACHED TO HARDWOOD RECT, POLES
The Wing tip used for a proof load weight 8.5kg (18.7lb) length 1.8m.

RIB POSITIONS	**1.8m**	**1.7m**	**1.5**	**1.2**	**900mm**	**600**	**300**	**0**	**= 4.4 G**
=84lb									
LOADS APPLIED		**29lb**	**60lb**	**121**	**144**	**156**	**163**	**168**	
3/4 LOAD		**22lb**	**45**	**91**	**108**	**117**	**122**	**126**	**= 4.4 G**
at ¾ LOAD									
								630lb	

OTHER VARIATIONS WERE TRIED AND NO PROBLEMS WERE FOUND.
PLEASE NOTE THAT WHEN I HAD THE POLE LOADED TO THE FINAL LOAD OF BRICKS
I THEN REACHED FOR MY CAMERA THAT THE LOT FELL OVER. AS YOU SEE APOLE APPROX, 100MM WIDE
IS NOT A GOOD PERCH FOR THAT MANY BRICKS.

WING AND FUSELAGE ALIGNMENT.

In looking to the alignment of your wing. Let me stress that it all begins with your ribs. The rib jig needs to be made accurate, as you will use many ribs the same. Slight profile problems can be in the area behind the spar. Now the vertical rib members that go in front of the spar are the most important, for if they are not your rib alignment will be all over the place. I use a cam action clamp on the jig to ensure it is in good contact with the jig block. this cam is nothing more than a circle of 6mm ply with an offset hole for a screw. You place the vertical rib member in and turn the circle till it holds it firm. You may have too experiment to get it to hold firm.
Also I strongly recommend that you obtain a thin sheet metal to make a master template of rib No A .Carefully cut a couple of slots at the front vertical position. The idea of this is that when you have made your ribs it can be overlaid to mark the LE edge cut out, the cord line and most of all the shape around the nose area so you can mark and clean up to an accurate shape. As I have explained in my drawings, I leave the rear spar vertical loose to be glued in after the ribs are installed. The reason for this is that it only takes a minute fraction of thickness change in the spar width to jam the rib while being installed. This means filing the rear member which it a lousy job and not very satisfactory. This rear member is taken out and fitted later. Of course the diagonal and gussets are installed. the final gusset is fitted with the rear member.
This may seem a bit of work but it means assembly will be accurate.
I use a piece of timber as a spar jig with a width to suit the spar and about 50mm thick. Select a dry piece and very straight. Mount on say 3 or 2 fixed stands or weighted saw horses. 2.4m is what you want. You can attach bit of ply or timber up one 50mm edge to keep alignment when assembling the spar's.
To the assembly of the ribs to the spar I have pieces of timber coming out from my bench top, these I align very carefully. I use eye sighting. I first use a level then I position myself at the end and raising my head up and down LOOKING for when one end disappears behind the other, if there is a twist it will appear like a wedge one end going first. The stands you use for the spar can be used with timbers hanging out off to one side. It all depends what space you have. Hard to set up in the bed room or lounge. This is a double check. Now when you sit your spar on these you will also see if there is any gaps under the spar. You will have marked the rib positions while making the spar. This assembly point will need to be high enough for the trailing end of the rib to be clear of the floor. Once you have slipped the ribs on and glued the front member in place and dry you can turn the whole thing over and check the alignment of the trailing end of the ribs. One thing when fitting the ribs either sit the top cap strip of the rib on the spar or with a packer to even the gaps top and bottom. I should have told you to do a dry run with the ribs either tacked in place or a way that suits you. And get down and look along the rib ends to check alignment. If you have done it well they will. I also purchased a length of aluminum flat bar 50 x 3mm to use as a straight edge.
Now you can add the rear spar (same rules apply) the trailing edge strip, ash blocks etc. When sturdy enough lay it on your work bench and use 2 sight bars to check for twist. These sight bars are 2 bit of timber that sit on the spars or even the end ribs. They only need to make contact at 2 points \ The front spar or on top of the rib at the spar and the rib at the back. If you use a couple of small bit of ply hanging down to clamp to the end rib

➡

ply. They must I repeat must be the same. Then you can sight or even use an adjustable level.

The same checks apply when fitting the LE ply.

Now to hold this while the glue sets there are many ways. Use staples if they are the thin wire type, and you have help and more than one staple gun. Not the thick rectangular type, they can split the timber Tack strips can be used but take a lot of time to set up. I have used them a lot 3/8" in strips of scrap 1.5mm ply. My time is my own. I don't pay myself at all..

Luggage straps. Bungee straps. and any thing that suits. But don't use something that will twist or bend. The lower surface may need packers to keep the ply in contact.

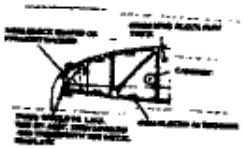
Back a bit, the leading edge cut out and trailing are a good indications if you are on the right track..

Treat the wing tops in the same faction. So what ever you use, either levels, sight boards or laser levels or beams, take your time.

I have not gone here into the blocks or hinge fittings etc they are discussed elsewhere.

There is one more thing, I carried the ply on the LE top back to the rear of the spar. This will be better. Also I used 8mm wide fill strips between ribs to attach the ply.

Once the LE ply is fitted there is no reason why the wing sections will twist.



One sight board can be used with an accurate level or 2 if using the sight method. If you use 2 they must be the same. As I said earlier you can fit ply scraps to hang over the side if using on the joint ribs. Laser leveling can be used but it depends on which type of equipment is used.

This is my basic way of doing this operation. I look check and double check every step of the way.

FURTHER DETAILS ETC.

STRAIGHT TAPER TIP.

FIRST ABOUT ROY De STADLER'S WING TIPS. ROY WAS LOATH TO TACKLE THE ELIPTICAL TIPS.SO AFTER DISCUSSION I SUDJESTED THAT HE MOVED THE "C" RIB TO THE "D" POSITION THEN USING 3 "A" RIBS. THEN USING A STRAIGHT EDGE FRONT AND REAR FIND THE LENGTH OF THE RIB THAT WILL FIT IN BETWEEN. USE THE CORDS TO CALCULATE THE PROFILE. THE WING TIP CURVE TO YOUR LIKING. (SEE PHOTO) CHECK THE LENGTH FROM NOSE TO SPAR. BY DOING THIS YOU WILL HAVE A STRAIGHT LEADING EDGE. BUT AT THE JOINT OF THE TAPER TO THE STRAIGHT INBOARD SECTION THE SPLICE ANGLES WILL BE DIFFERENT TO NORMAL. EVEN A SHALLOW ANGLE ON THE TIP SECTION, EVEN IF IT LEAVES A WHAT LOOKS LIKE A LAP JOINT. THIS IS NOT A PROBLEM.

SPOILER.

YOU MAY CONSIDER IN THE AREA WHERE YOU LIVE TO USE THE COMERCIAL SERVO'S USED FOR TRIM TABS ON OTHER ULTRA LIGHT AIRCRAFT. IN FACT ANY METHOD TO DEFLECT THE SPOILERS.

IN FACT IF YOU ARE A GOOD TAIL WHEEL PILOT YOU MAY NOT NEED THEM. GRASS FIELDS WHERE YOU CAN LAND INTO WIND ARE GREAT. THE TEST PILOT EVEN LANDS DIAGIONAL ON THE STRIP AS DO OTHERS.

UNDER CARRIAGE.

HENRI MIGNET WAS CONCERENED WITH TIPPING ON HIS NOSE SO PUT THE WHEELS WELL FORWARD. ALL PILOTS SAY NO TIP. (SEE FLIGHT REPORTS) IT WOULD BE A BETTER POSITION IF 80mm BACK.

THIS I AM LOOKING INTO.

FABRIC.

I USED 1,7oz FROM AIRCRAFT SPRUCE. OR 2,7oz WOULD BE OK. SAY ON THE FRONT WING TOP. I CAN NOT STRESS MORE THAT IF YOU ARE NOT GOING TO RIB STITCH TO BOND TO RIB CAPS CAREFULLY. I HAD THE METHOD APPROVED BACK IN 1959 FOR USE ON THE "PIEL EMERAUD'S". 2 BUILT AND 3 UNDER KIT CONSTRUCTION.

STRUT END.

YOU WILL NOTICE IN THE CONSTRUCTION NOTES A REFERENCE MADE TO 20mm DISTANCE FROM THE WING SURFACE. THIS IS A MIN, DISTANCE TO ALLOW FOR THE SIZE OF THE STRUT END OR BOLT OR CLEVIS BOLT. IT CAN BE A BIT MORE, BUT REMEMBER THE HOLE CENTER MUST BE THE SAME AS THE CABANE PIVOT POINT DISTANCE.

CABANE BOLTS.

YOU WILL NOTICE ON THE PHOTO'S OF THE NEW CENTER SECTION THAT THE THROUGH BOLTS (5/16") THE TOP IS RECESSED INTO THE SKIN. THE ASH HARDWOOD BLOCK IS IF YOU WISH 8mm ,THEN A FILLER OF PLY OR SPRUCE IS ADDED UP TO RIB TOP LEVEL. THIS HAS A ROUND END RECTANGLE HOLE TO TAKE A , I USED 1.5mm ST STEEL PLATE WASHER, THIS WILL THEN ALLOW THE NUTS ON THE BOLTS TO BE RECESSED INTO THE TOP. THE D NOSE PLY IS CUT

OUT TO SUIT. THE PIVOT BRACKETS BOLTS , TOP WASHERS AND NUTS ARE FITTED FINALY AFTER THE FABRIC IS APPLIED. YOU MAY STICK TO THE ORIGINAL METHOD, THAT IS UP TO YOU.

FINAL THOUGHTS AND COMMENTS.

We now arrive at the end of this CD on my efforts and assistance [illegible] rs on building a Flying Flea. I must say this, if you have caught the Flea bug like I did as a young man and want to get started on building your own talk to a current

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SOME COMMENTS.

I caught the Flea bug when young working in the aircraft industry Now if you are interested at this point in building a Flea do talk to a Flea builder or a pilot who has flown one. Do not listen to unfounded comments of people who have not built or flown one. There are knockers of Fleas as there are about other aircraft. All types of aircraft have accidents for one reason or other. Now think no spins, no spins due to tight turns. Able to do a parachute decent. Please read the pilot notes that follow (page 39). You will find that even though a full test report is not given, let me assure you Kirk Sutton put this AC through an extensive program.

The Flea concept has over the years since the mid 30's has had more changes and modifications than any other AC I have known. It lends itself to variations but it must be researched and confirmed before changes are made.

In the 59—60's I built 2 Piel Emeraud's a two seat semi aerobatic Ac as well as 3 kits for them. I was involved in some parts for the original Corby Starlet, and 3 sailplanes. Since retirement have helped in the building of two Zenair 701's, a Pitts two seater. Also some other bits and pieces.

I started as a young lad during the 39-45 war working on Avro Anson's and Air Speed Oxfords so called bombers. Lots of wood in the construction. I drove the tradesman mad with "let me do it" or "Show me how". I spent much of my working life in the AC industry.

You will see some photo's of Roy De Stadler's AC he is building in South Africa You will see he is doing a great job of it. He had no previous experience.

Read the book and study the photo CD till you know it by heart. Drive your other builder friends mad with questions, but do not listen to advice that the" Bloggs Special" is the best. You decide. There are two Fleas built in Tahiti that are on floats that they say are easy to fly. Phillip Howell in the US has over a 1000 hrs flying time on his Flea.

In closing this page I thank all who have helped me.

PILOT NOTES "FLYING FLEA" HM 290/3 FB
AUSTRALIAN ULTRA LIGHT REG No. 10-1438
AUTHOR KIRK SUTTON Test Pilot

Introduction

These notes are based on the test flights of HM 290/3 FB and are intended to provide general guidance on how the flying flea as an aircraft type handles and in particular how it compares to a "standard" aircraft in terms of handling on the ground and in the air. These notes are aimed at familiarizing an already trained pilot with the differences and features to expect in this aircraft and are definitely not intended to be used by an untrained person to become a pilot and immediately acquire the ability to fly a flea.

I urge any potential Flea pilot to get training on light/ultra light aircraft prior to any attempt at flying their Flying Flea. In addition I strongly recommend that the initial flight of a new flea be undertaken by either another experienced flea pilot or an ultra light test pilot/instructor/high time pilot. It is an extremely undesirable situation for a low/no time pilot not having flown a flea to make the first flight in a new flea as they will be unable to tell if the flight behavior is a result of an issue with the aircraft or of pilot inexperience.

If you as a builder are a low time pilot without prior flea experience and have no opportunity to have the flea test flown I recommend that you read the notes below, speak to other experienced pilots as to what to expect and plan ahead of flight what the expected corrections are to flight issues that are likely to arise. I counsel against getting advice only from pilots who have not flown a flea as they will almost certainly give you incorrect and potentially dangerous advice on actual flight responses. I say this from personal experience as I prepared to fly this flea for the first time.

I spoke to both experienced flea pilots and "standard" aircraft test pilots. I followed the handling advice of the test pilot over the experienced flea pilot to my detriment on the first flight. Fortunately I had already planned my responses to likely handling problems and as I went through the handling problems my pre-planned actions and ultimately the flea pilots' advice proved extremely valuable.

Fred Byron was present for my first flight and has my complete permission to tell anyone who asks both what happened and how it felt for those on the ground watching it I will simply say that it is the first and only time to date when I was in an aircraft and wishing I was on the

ground. Having said that I love to fly the flea and fully accept that the way that initial flight scared me was purely due to my own actions and lack of understanding as to what was going on – I had neither knowledge nor control over what was happening and that is not a pleasant experience.

In addition Gus Morrison was my low time student pilot for whom the original handling notes were framed to allow him to convert from a known 2 seat tail wheel training ultra light to this single seat flea. His first flight was beautiful to watch as the pre-knowledge of the particular behavior he could expect and agreed pre-planned handling responses to counter them made his first flight better than any of my first 5 despite his having well under 50 hours total flight experience at the time.

I generally agree with Henri Mignet on building a flea – high school metal and wood work will equally allow you to build a packing case and a flea – no exceptional ability is needed to build one. However, I disagree entirely that once you have finished building you can just jump in and safely fly it. Maybe you will, probably you will not. You have already spent a lot of time and money on your flying packing case, invest a little more in learning to fly before you break either your pride and joy or your neck.

Ground Handling
The HM290/3 FB an aircraft with tail wheel landing gear and compared to "standard" tail wheel aircraft has a short fuselage and wheel base. The tail wheel is operated by foot controlled pedals as are the main wheel brakes. Unlike many Flying Fleas the rudder alone is connected to the lateral movement of the control stick.

I have flown an HM14 where the tail wheel was controlled on the control stick and found that the weight fed back through the stick was unpleasant and surprising/unexpected as more weight came back through the control stick as it was progressively moved to the side.

My preference is for foot operated tail wheel steering if possible as any variation in pressure feedback through the foot pedals will be more naturally and easily handled.

General Comments.

- The flea is a tail wheel aircraft
- Steering is by pedals ("rudder" pedals)
- Pedal travel is very short compared to many other aircraft
- The first 2/3rd travel is tail wheel only and differential brake after.
- Due to set up of flea –CofG. Is a long way behind main wheels
- Wheel base is short.

The result of these factors is that the flea will swing easily and once started will swing rapidly and strongly during ground handling. Attempts to correct ground swings can inadvertently engage the brakes and cause overcorrection with resultant swing in the opposite direction. For these reasons I would recommend not linking the brakes to the tail wheel pedals but have them on separate hand operated ~~break~~ brake levers.

Note: provided the take off and landings are dealt as set out below this flea is not a difficult tail wheel aircraft and is definitely not beyond a trained tail wheel pilot.

Like all tail wheel taxiing the aircraft and all ground maneuvering must be at low speed. Unlike a "standard" tail wheel aircraft where pilots can perform high speed taxiing with the tail up under moderate power you cannot do this in the flea.
Any attempt at high speed taxiing in the flea will not raise the rear wing and will simply end in a dangerous high speed ground loop and probably damage to your flea.

With the high nose cowl and low seating position forward vision is poor directly ahead but adequate vision for taxiing exist by looking out each side. It is small enough not to require S turning as it is possible to have adequate forward vision from either side. The positive steering on the ground combined and the very small size of the Flea will not require a wing walker as the side area of the flea is insufficient for any wind you can operate in to cause difficulty.

When taxiing and a swing commences into a ground loop the best advice is to cut all power and gently correct the turn. Once familiar with the aircraft the ground handling is comparable with any other tail wheel aircraft with a short wheelbase.

During preparation for initial flights I strongly recommend that only low speed taxiing is attempted. Due to the very short take off and landing runs there is no benefit to be had from attempting to do high speed runs that are operationally unnecessary. In addition they will expose you to the increased risk of ground loops from higher speeds. I recommend that once comfortable with low speed taxiing you progress to the actual take off.

Take off
The HM 290/3 FB is fitted with the Coesandy flap in the rear wing. This is a reflex flap only and it can be used to decrease lift on the rear wing during take off and landing resulting in greater weight on the tail wheel. This increased weight can assist in maintaining the effectiveness of the tail wheel steering during take off and landing.

It is not essential to use the Cossandy flap during take off but it does provide an additional degree of control and use of 1 notch of flap will result in tail wheel steering remaining positive right through to take off roll with no period of ground run where neither tail wheel nor rudder feel effective. Without the use of the Cossandy flap there is around 1 second of the take off run when there is a feeling that neither the tail wheel nor the rudder are completely effective but it passes and I experienced no actual problems in operating without flaps during all crosswind trials where up to 6 knots direct crosswind was tested.

General Comments

- Ground roll on take off is short – around 75M (225ft) from a standing start
- Recommended initial flights should be with 1 stage flap (5 degrees)
- Line up and roll straight to ensure tail wheel is straight before adding power
- Move stick forward to minimize lift & drag on front wing during acceleration – 2/3rd forward travel
- The push on the stick is around 2-2.5kg (5-6lb)
- The weight on the stick will disappear immediately once the throttle is opened
- Swing from prop torque is to right – stick to the left of centre approx 2cm (1")
- Unlike a "standard" tail wheel aircraft it will remain firmly on all three wheels.
- Once 45 knots indicated gently pull back on the stick and the flea will freely come of the ground main wheels first.
- Once in the air let speed settle to 50 knots with weight on stick approx 1-1.5 Kg (2-3 lbs) back pull with stick slightly to the left of centre.
- Note – nose is very high in the initial climb, higher than ground attitude.
- Passing 3-400feet set flap at 0 degrees and climb away at 45.50 knots indicated.

You must not ever attempt to fly a "normal" tail wheel take off of remaining on the ground until the rear wing lifts. To do this in the HM 290/3 FB requires well over 60 knots and is extremely dangerous as forcing the front wing into the ground

To remain on the ground and are liable to ground loop from high speed with dangerous results

You must allow the flea to fly away from the ground once flying speed is achieved. It is a difference from "standard" tail wheel aircraft that must be accepted that on this flea the tail will come off the ground after the main wheel and not before. Note – the HM14 tested with HM293 wings did raise its rear wing early in the ground run on take off. This was a result of its total wing loading and cofg/main wheel location being quite different from the HM 290/3 FB. Whatever flea you are flying you must allow the aircraft to fly away once airspeed is sufficient for flight, do not force it into operating as a "standard" tail wheel aircraft.

The likelihood is that the initial flight will be accompanied by a degree of pilot induced roll. As a result I do not recommend low hop flights as it forces you to handle a take-off, deal with any roll and then complete a landing all within a few seconds – this is generally an overload for you as the pilot. I counsel people to undertake a complete and safe first flight with the intention of take off and climb well away from the circuit to get a general feel for handling of the flea in the upper air and practice several landings sequences at altitude before returning to the circuit area for actual landings.

You can't stall the flea in the sense understood for 'standard' aircraft. With full power and 1 stage flap this flea has sufficient power to enter a no-climb/no-descent series of gentle undulations in attitude as the front wing cycles through it's stall/unstall cycle. Like all canards in a stall the nose will 'bob' as the front wing unloads and reloads but with the Rotax 503 this flea has sufficient power to not loose any height during the cycles. This flea with full power and full back stick simply stops climbing but weight on the stick is significantly higher as speed falls below 45 knots providing very positive warning of approaching stall of the front wing.

The flea is liable to pilot induced roll as the control effectiveness of the secondary effect of rudder is very powerful and inadvertent pilot induced roll is very likely for low time pilots and any 3 axis pilot. When the flea starts to roll from side to side you must stop it by positively

- Holding the fore-aft stick position for climb speed and
- Holding side stick 2cm (1" either left or right to commence a turn

If you do this it will stop very quickly. NEVER make rapid or large side –to-side movement to stop uncontrolled rolling as this will

dramatically increase both the degree of roll and speed – see comments below on lateral/roll control.

Flight handling
General comments
Stability
Pitch – the flea is pitch stable with no difficulty in holding a desired wing position/speed. Without a trim device stick free stability can only be tested in the 10-20 degrees Cossandy flap position where the stick naturally goes full forward.
In this condition it is positively pitch stable with return to stable "bobbing" of the nose.

Yaw – this flea will maintain heading without any 'snaking' at speeds up to 60 knots as the rear wing is producing significant drag due to the angle of attach with is acting aft of the confg. This aerodynamic drag is adding to the aerodynamic stability from the fin/rudder. Above 60 knots the aircraft becomes progressively less stable as the drag from the rear wing reduces as its angle of attach reduces. The flea initially tended to snake slightly due to minor movement of the stick which was mildly divergent i.e it became progressively more snakey and increases left/right with the stick wanting to wander with the yaw which induced roll. This was easily controlled by positively holding the stick controls and countering yaw/rolls as they developed but was not satisfactory. To address the snakey habits a smaller rudder was fitted. This removed the floating of the rudder at higher speed and reduced the 'snakey' wandering of the flea. This was particularly interesting as the difference in rudder size was only 1 square foot.

Roll – at speeds up to 60 knots the aircraft is positively stable in roll and returns quickly to level flight. Above 60 knots the roll is still stable but initial flights with the larger rudder inducing a roll that became divergent and progressively larger. This was a result of using the larger rudder and that tended to float from side to side. Replacing the rudder with a slightly smaller one returned the roll stability at all speeds tested.

Maneuvering
Roll and yaw
Fleas have no direct roll control via aileron but rely on the secondary effect of rudder. However, the secondary roll of rudder is very strong in a flea due to short span and very low aspect ratio. In practice the primary effect of rudder is often not noticed as the flea rolls with the rudder quickly, primary rudder effect simply working to maintain a balanced turn without coordination by the pilot. As the effect of

rudder in a flea is equivalent to the effect or ailerons in a 'standard' aircraft it is sane and logical that fleas have rudder control on the side stick movement where you would expect to find ailerons. Pilots trained in 'standard' aircraft will get the control response expected from a known control device.

The flea does have a peculiarity relating to the roll control via the rudder secondary effect. Rolls instigated by rapid and large movement of the stick into a turn have a delay or lag between the input and the roll commencing that is not present if the input is small and gentle. Gentle use of the rudder will result in gentle progressive turns with little or no delay. Rapid and large displacement of the rudder will result in delay to the roll commencing but when it starts it rolls very quickly if you hold in the side stick. I recommend that rapid side movements of the control stick are to be avoided in initial flights because the speed of movement affects the amount of delay in the roll effect and the rate of roll. It is very easy for a pilot to experience this, over correct the reverse direction too fast and initiate pilot induced roll where the roll appears to completely out of phase with the control stick inputs – very scary if you don't know what's happening.

- General turns are accomplished by gentle smooth movement of the stick in the direction of the turn with the side stick held into the turn. This is different from many 'standard' aircraft as the flea will instantly start roll out of a turn as soon as the slide stick is removed/relaxed.
- You can't hold rudder against the turn as a 'standard' aircraft requires in a very steep turn as opposite rudder will roll out of the turn. As a result you cannot do very steep level turns or stall in the turn because the flea just enters and holds the correct angle of bank in a descending turn for the rudder held and the power set.
- Caution – rolls instigated by rapid movement of the stick into a turn have a delay or lag between the input and the roll but when it starts it rolls quickly if you hold in the side stick.
- After you are comfortable with flying the flea demonstrate that it is roll stable and has lag in response if the input is rapid as follows:
    - At altitude and after checking area clear establish straight and level flight at 65-70knots
    - Rapidly move stick left and right without holding it at side for any time and return to central
    - The flea yaws minimally but doesn't roll.

Why? Because by the time the roll should start after the lag the rudder is already opposite i.e. without holding in side stick there is no roll.

Repeat the test but hold the side stick after rapidly moving the stick to the side. The result will be a delayed start of the roll then very fast roll. As soon as the wings pass 30 deg. Immediately return the stick to the centre and hold the position
DO not take the stick past centre as you may cause a rapid roll to the opposite side. If the stick is held centre the Flea will continue to roll but will then gently reverse the roll and return to wings level.
Note – if you are not comfortable with STEEP turns do not do this part of the testing.

- As rudder creates roll in the flea you can't hold any degrees of slip. The only way to alter heading/yaw is to actually make a turn onto the heading you want. It's a little imprecise at first so this is an additional reason to do powered approaches to start with, final is longer and you have more time to get in on the runaway heading.

Pitch
The fleas 'elevator' is the entire front wing which is variable in incidence at the direct control of the pilot by for/aft movement of the control stick. The centre of the lift of the front wing is very close to the cofg. For the aircraft which means that changing the pitch of the front wing does not affect the pitch attitude of the aircraft but simply increases lift and drag. The pitch attitude of the fuselage is a result of the airspeed and not the position of the 'elevator'
The practical implication of this is that when you pull back on the stick the flea will simply increase the rate of climb without noticeable change in either the fuselage attitude or the 'picture' the pilot sees. As the increased drag from the higher front wing incidence starts to lower the airspeed the rear wing will start to loose lift and the rear of the flea will gently lower adjusting the pitch of the fuselage.

This is a difference from 'standard' aircraft where the initial change from pulling on the stick is attitude change followed by increased lift. This change from 'standard' is very useful in landing a tail wheel flea as during hold off the flea will automatically adopt a three point landing attitude as the flea slows down.

In flying the flea it is best to learn the combinations of stick position/weight and pitch attitudes for various flight regimes.
e.g. full power climb, cruise, reduced power decent etc and the 'picture' you see out the front. The flea has lots of forward reference points for these pictures e.g. the cabane struts, upper engine cowling.
This Flea does have definite pitch attitudes as follows:

Pitch attitudes of fuselage.

- Reference attitude = ground attitude (around 5-7 deg nose up)
- No flap Full power climb at 45-50 knots – slightly higher than reference (10-12 deg nose up)
- Straight and level in cruise at 65-85 knots – lower than reference with upper fuselage longerons level (0 deg)
- Cruise power descent 65 knots (5,000 rpm) – much lower than reference (10 deg nose down)

Use of the Cossandy flap will increase the fuselage attitude in all flight regimes with increased flap settings increasing the nose up attitude. For example full power climb with 5 deg flap will increase nose up fuselage attitude to around 20-22deg i.e. 10 deg. Increase in fuselage attitude. At the extreme of full flap, low power and full back stick the flea enters full parachutal descent with minimal forward speed (under 20 knots), fuselage 30-35 deg nose up from level and with rapid vertical descent (well over 1,500 fpm). This flea flown at gross weight must not be flown in parachute descent for landing approaches due to the excessive vertical decent rate that requires both power and time to reverse. All landings are to be glide and/or power approaches which still result in short landing runds.

Cruise Performance.
Straight and level can be maintained at any speed from 45-87 knots on various power settings. Below 60 knots there is a noted pitch up nose attitude above 60 the fuselage is basically level.
This table refers to the climb prop.

Power
Speed (knots)
Nose Position
4,000
42-45
Up 15 degrees
5,000
50-55
Up 5-10 degrees
5,200
55-60
Level
5, 4-5, 800
65-70
Level
Full
75-78
Level

Cruise prop amendments
Top speed indicated in S & L with this prop is 87 knots at 6,300 rpm. This prop is slightly over pitched and below 5,200 rpm pulling back on the stick loads the engine and the engine rpm starts to reduce. It must be power first then attitude, if you pull up in other respects it is normal.

Landing
The landing run for the Flea is short even without use of brakes – around 70M (250ft) from touch down. Use of braking will reduce this marginally to around 60M

This method recommended for early landing is a powered with flap approach as follows:

- Set Power on base to 4,000 and extend 1 stage flap (5deg)
- Fly a close circuit as glide performance is poor and approach angle is steep
- Settle speed to 60-65 knots indicated for approach and turn final
- On final just use power to adjust descent rate – but no lower that 4,000rpm
- Over the fence aim for 20ft to commence flare
- Caution – positively ensure that your feet are on the tail wheel pedals and that are central before you cross the threshold
- Commence flare as normal by pulling back on stick gently/ progressively to enter hold off
- Caution – you must be straight or go around
- As speed decays the rear will gently lower to the three point attitude
- As the main wheels touch throttle closed and stick full forward
- Touchdown is around 40-42 knots but speed isn't essential as this flap/power settles the flea and it will not balloon.
- Without power the speed will rapidly decay – retain full forward stick until under 20 knots to retain weight on the main wheels
- Under 20 knots progressively move to full back stick and this will substantially increase drag and increase braking.

With flaps 0 degrees landing is the same as above but Flea will float a bit and tail wheel steering once on the ground is not as positive until it slows down. The Flea may swing first so I recommend 1 stage landings until you are happy with the handling.

Glide approach exactly the same as powered approach except best glide speed is 55-60 knots however to retain authority to flare and enter hold off it is best to increase speed to 60-65 knots indicated below 300 ft.

Stalls.
General comments.

I disagree with everyone who says that the Flea cannot stall – wings of the Flea CAN stall. What is different is that the Flea is a canard aircraft and unlike a 'standard' tail-at-the-rear aircraft the Flea will enter a canard stall cycle and will not exhibit a definite 'stall break' and large pitch change. What occurs as the front wing stalls is that the front wing unloads resulting in a gentle lower fuselage attitude which then results in an airspeed increase followed by a gentle pitch
Increase. This canard 'stall' cycle does involve an aerodynamic stall of the front wing – the gentle pitch lowering is a result of the lower lift from the front wing as it stalls.

Stalls – canard unloading – pitching – loading
The Flea is set up as a canard type aircraft with the front wing being more heavily loaded due to strict cofg limits. The front wing also has a much higher relative angle of attack to rear wing as a result of both the inter-incidence between the front and rear wings at full back stick (6 deg) and the downdraft to the rear wing from the front wing which effectively lowers the effective incidence of the rear wing.

As a canard the sequence is:

- **Pull back on the stick**
- **Aircraft initially climbs in same fuselage attitude**
- **Aircraft starts to slow**
- **Aircraft starts to pitch up (loss of lift on rear wing)**
- **Weight / back pull on stick increases noticeably**

- **Front wing starts to stall which is noticed as 'booming' from wing skins and strong shaking in the stick, continue to pull back on the stick**
- **Weight on stick increases until the front wing unloads after the stall of that wing.**
- **Nose lowers**
- **Front wing has lower angle of attack**
- **Front wing un-stalls**
- **Sequence repeats with nose ' bobbing' up and down gently**

Specific stall information with varying Cossandy flap settings

No flap

The front wing acts as full span slot to rear wing increasing the lift on the rear wing. This means that this type of stall is the gentlest and with medium to high power (5,600 – 6,200 rpm) there is no height lost. The nose is quite high and unload / lowering of nose happens at full back stick. Indicated airspeed just under 40 knots – no loss of height with cruise power setting.

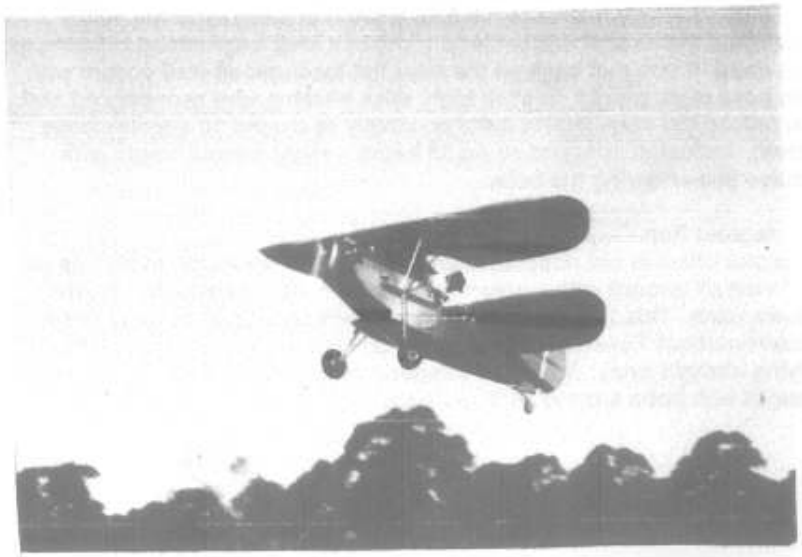
5 degrees flap
Similar to no flap except weight on stick is higher and unload may occur just before full back stick. Nose attitude is slightly higher and the nose lowers slightly more than no flap i.e it bobs a bit more. Indicated airspeed about 40 knots – no loss of height with cruise power setting.

10-15 degrees flap
The slot effect doesn't appear to be as pronounced. With these settings the stick naturally moves to full forward and at medium to full power and if allowed the aircraft will settle to climb in a stall load/unload bobbing of the nose. If you pull back on the stick full load/upload stall occurs with the nose high, weight on stick high, stick shaking very pronounced and on unload the nose lowers quite positively to around 10 degrees nose down. Indicated airspeed about 35 knots – slight loss of height with cruise power during the bobs.

20 degrees flap
The slot effect is not noticeable and the aircraft "appears" to stall as per a "normal" aircraft with a very steep nose up attitude with rapid nose down pitch. This is approx. 40 degrees nose up and 20 degrees nose down in about 1 second. As soon as you release back pressure it starts flying straight away. Indicated airspeed well under 35 knots with loss of height with bobs around 50 ft. per bob.

A NOTE FROM ME (The builder)

I feel I must comment on Kirks modesty about his first flights.
The day of his first it was decided he would only do a taxi run as at this time the birds were either walking or hiding behind the hanger like us spectators. Blustery and very gusty, you get the picture.
As he said the watchers (many) were panicking. But with modesty I realized he was chasing the bumps. Ask him to explain this stick reaction. Later I removed the brakes from the pedals and changed the tail wheel assembly. Also removed the springs in the cables on side loads (cross wind), could overcome there usefulness. Also the front wing span is a bit shorter on this AC owing to a miss understanding of French translation. I never said I was perfect. Remember anyone who never make a mistake, never made anything!

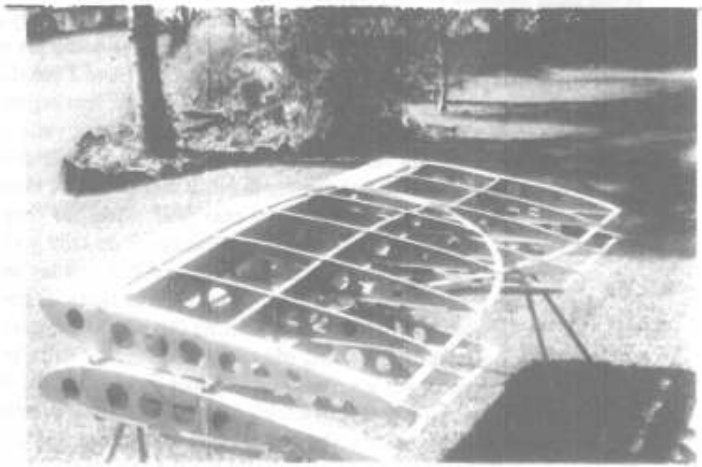


TEST FLIGHT.

MEMO

It has been bandied about a bit of late that Some of the problems of early Fleas the HM14 variety could be rigged with a twist, particularly towards the tip. This could take place because of the D nose not being ply covered. Also there are no diagonal bracing as used in some (And I use this term loosely-- normal AC). The external cables do this job, leaving room for rigging errors. This brings me to my point. When making your ribs it is most important to get the vertical member in front of the spar the same on all ribs. This is why I recommend using the cam action disk to clamp it firm to the jig block. The same applies to the rear spar. All other vertical and diagonal do not require or need the same accuracy. You only make the jig once so take your time and be accurate and neat. When you lay out the ribs position the leading edge slot, and have a template to mark its position, so all are the same. This way when you are fitting the ribs to the spar you have not only the LE slot but the trailing edge to sight along, or use a strait edge. Any that don't align may need a touch with a file on the vertical at the spar to correct. Also make a Level board with a block either end to bring the top of the board to be above the ribs but parallel to the cord line of the rib. Make in such a way that it can be indexed behind the front spar and to sit on both front and rear spars. Using your level you can check either end keep the alignment the same, thus give you a indication of your progress. To stabilise the rear of the ribs while fitting the TE glue lightly strips of scrap timber (say for example 6x3) inside the rib cap strips to hold firm. The reason I say inside is to keep glue off the outside as it will impair bonding the fabric. If you have a digital level all the better as you can apply then zero for comparison. (borrow one)

An other way is to fit the lower trailing edge gusset to the lower surface of the rib where it is cut off to give 12mm depth. Allow to extend 20 to 23mm. This will give you somewhere to sit the trailing edge which can also give you the correct alignment. The level board will come in handy when fitting the front wing to set the wing push rods and control levers to give the correct action. That is zero to 12deg. These points should be completed before the fabric is fitted. Remember that because when fitting the ply to the LE no matter what method you use, keeping it straight is important. Don't become concerned it is just a case of thinking before doing the job.



THIS IS THE WING SET AS MADE, I USED A.C. COACHWOOD PLY LEFT OVER FROM GLIDER DAYS. THE REPLACEMENT CENTER SEXCTION MADE LATER USED GIRDER TYPE RIBS. THIS IS CHEAPER MATERIAL COST WISE BUT TAKES A LOT LONGER. ? HOW MUCH AN HOUR DO YOU CHARGE YOURSELF.
A SATISFIEING STAGE WHEN YOU FIRST ASSEMBLE IT.

NOTES.

There are a couple of things that might occur to you as you now go through the drawings.
If you decide to use rudder pedals instead of side stick for the rudder, you could also think about placing the stick on the RH side. Leaving enough room for a big pair of knuckles.
While on the control stick, give some thought to adding some bungee to use as a trim device. It is used on the Baleret. The bungee's can be effective for trim.

One more thing when you get to study the UC you will notice ther is a bit of work in it and weight.
There are other types that would adapt. They may need a flat side to fix to. The side or bottom longeron if curved can have extra side timber added to make a flat surface. One reason to consider this is that if you wanted to move the UC back all it needs is to fit different bolt holes. Consider this when pitching the holes. Also the interior structure.

You will notice that using a GRP tank there is the need to glass in a tank cap, a drain adapter, and outlets.
What I do is clean the flange used to glass over, then mix the epoxy resin and using some sanding paper rub the surface with the resin on the paper. This will break through the oxidization and seal it to omit any air. You will see some gray powder in the resin this lets you know the job is done.

On the CD you will see the trim tabs on the front wing. In the shot the connecting spring wire to set them in a desired hole in the tab. They are shown out of the hole. The reason being is to clear the area so the rear wing can fold. This applies to this AC . Depending your Ac these tabs can be sized etc to suit after you have test flown.

NOTES.

DRAWINGS.

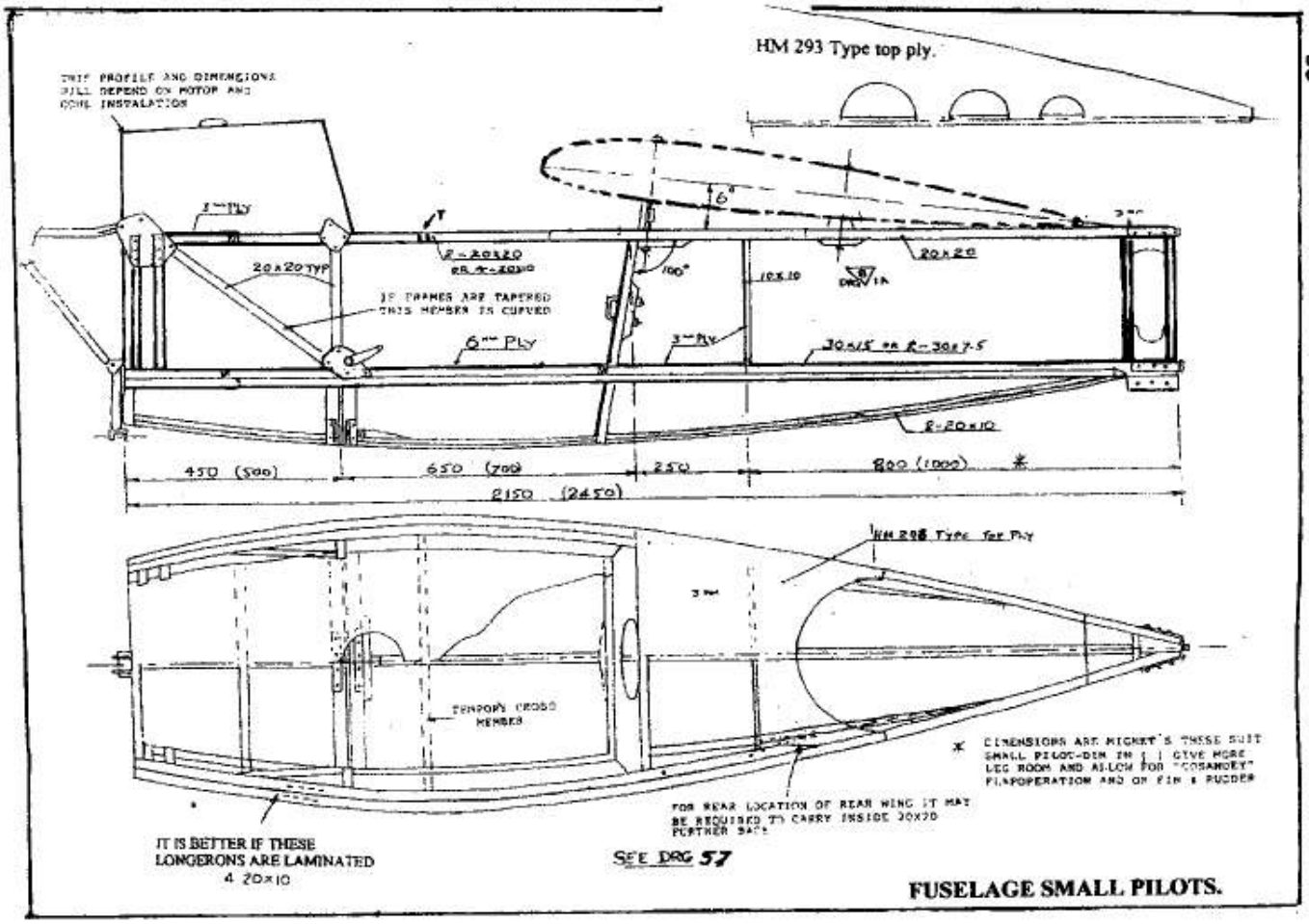
AND SOME DESIGN IDEAS.
AS WELL CofG INFORMATION.

You may find references on construction notes and drawings showing this triangle with a page No in it. Look there for more details.

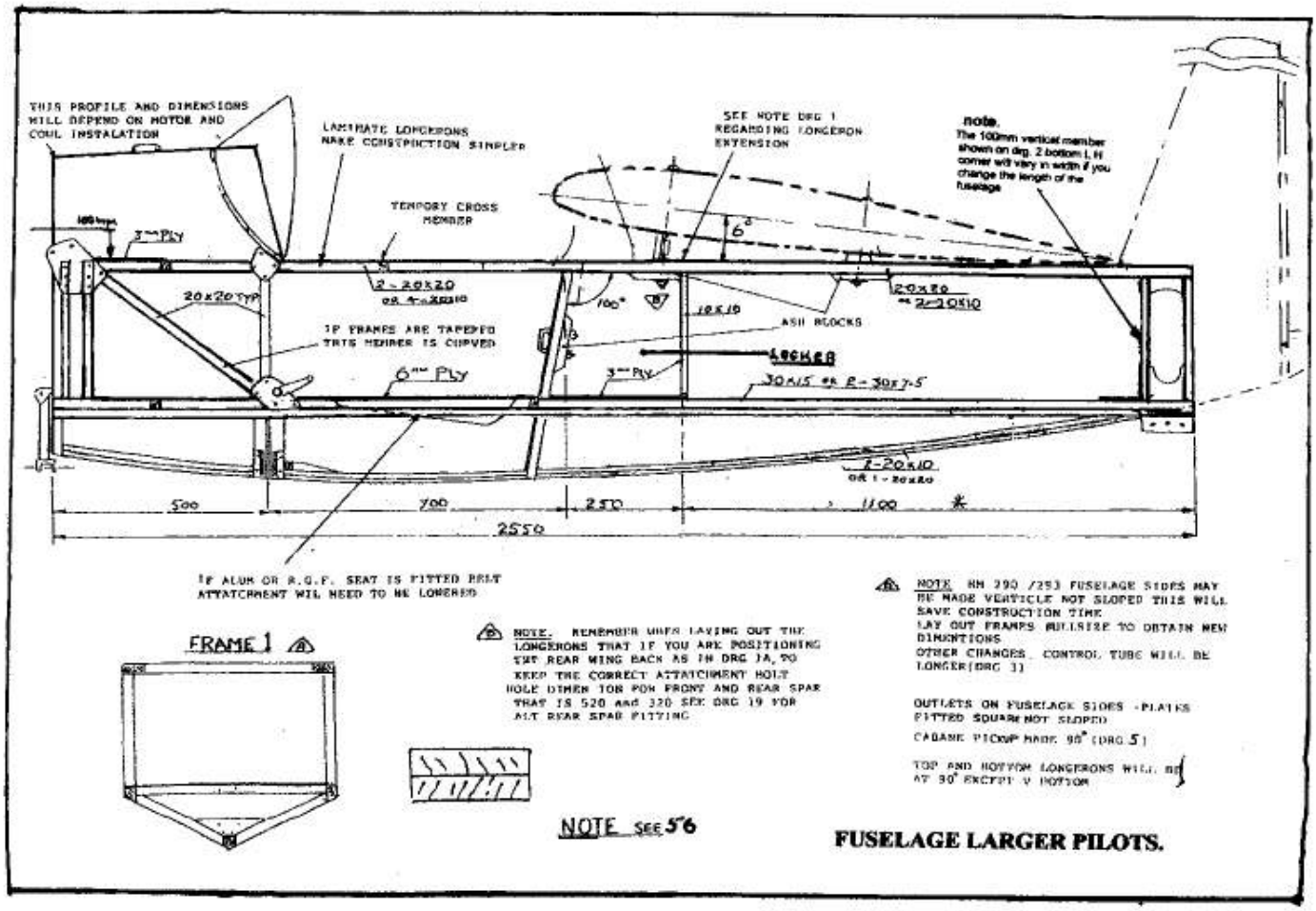
Either that or when you have read the book you will have a good idea where to find the information.
As there are several alternative's for some things you will decide what suits you best

NOTES.

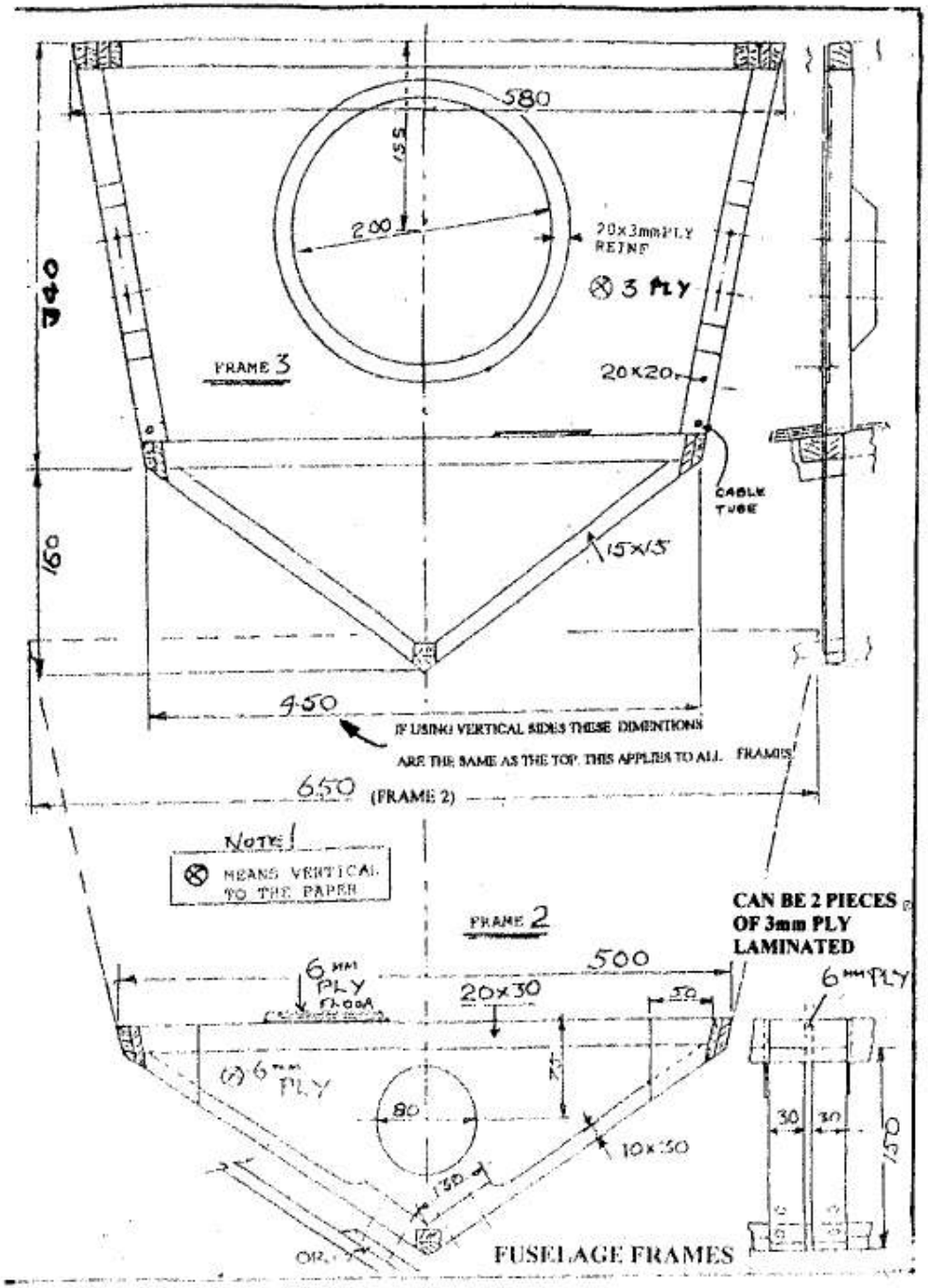
THIS IS AT A TRIAL FIT STAGE OF CONSTRUCTION. THE ENGINE MOUNT IS ONE MADE FROM SCRAP TUBE SO THE C of G COULD BE ESTIMATED. I FOUND OUT TWO THINGS ABOUT FLEAS. ONE IT MAY BE NESSESARY TO MOVE THE FRONT WING BACK OR FWD. TWO THE MOTOR MAY NEED TO GO FWD.
I REALISED THAT IT IS BEST TO MAKE THE MOUNT RAILS LONGER SO WITH THE MOTOR ON A MOUNT PLATE IT CAN BE SLID BACK AND FORTH TO OBTAIN THE BEST ADVANTAGE .


HM 293 Type top ply.
THIS PROFILE AND DIMENSIONS WILL DEPEND ON MOTOR AND COWL INSTALATION
3mm Ply
20x20 TYP
2 - 20x20 OR 4 - 20x10
IF FRAMES ARE TAPERED THIS MEMBER IS CURVED
6mm Ply
3mm Ply
10x10
20x20
30x15 OR R - 30x7.5
2-20x10
450 (500)
650 (700)
250
800 (1000) *
2150 (2450)
HM 298 Type for Ply
TEMPORY CROSS MEMBER
* DIMENSIONS ARE MICHEY'S THESE SUIT SMALL PILOT-DIN IN L.I GIVE MORE LEG ROOM AND ALLOW FOR "COSAMOEY" FLAPOPERATION AND OR FIN & RUDDER
FOR REAR LOCATION OF REAR WING IT MAY BE REQUIRED TO CARRY INSIDE 20X20 FURTHER BACK
IT IS BETTER IF THESE LONGERONS ARE LAMINATED 4 20x10
SEE DRG 57

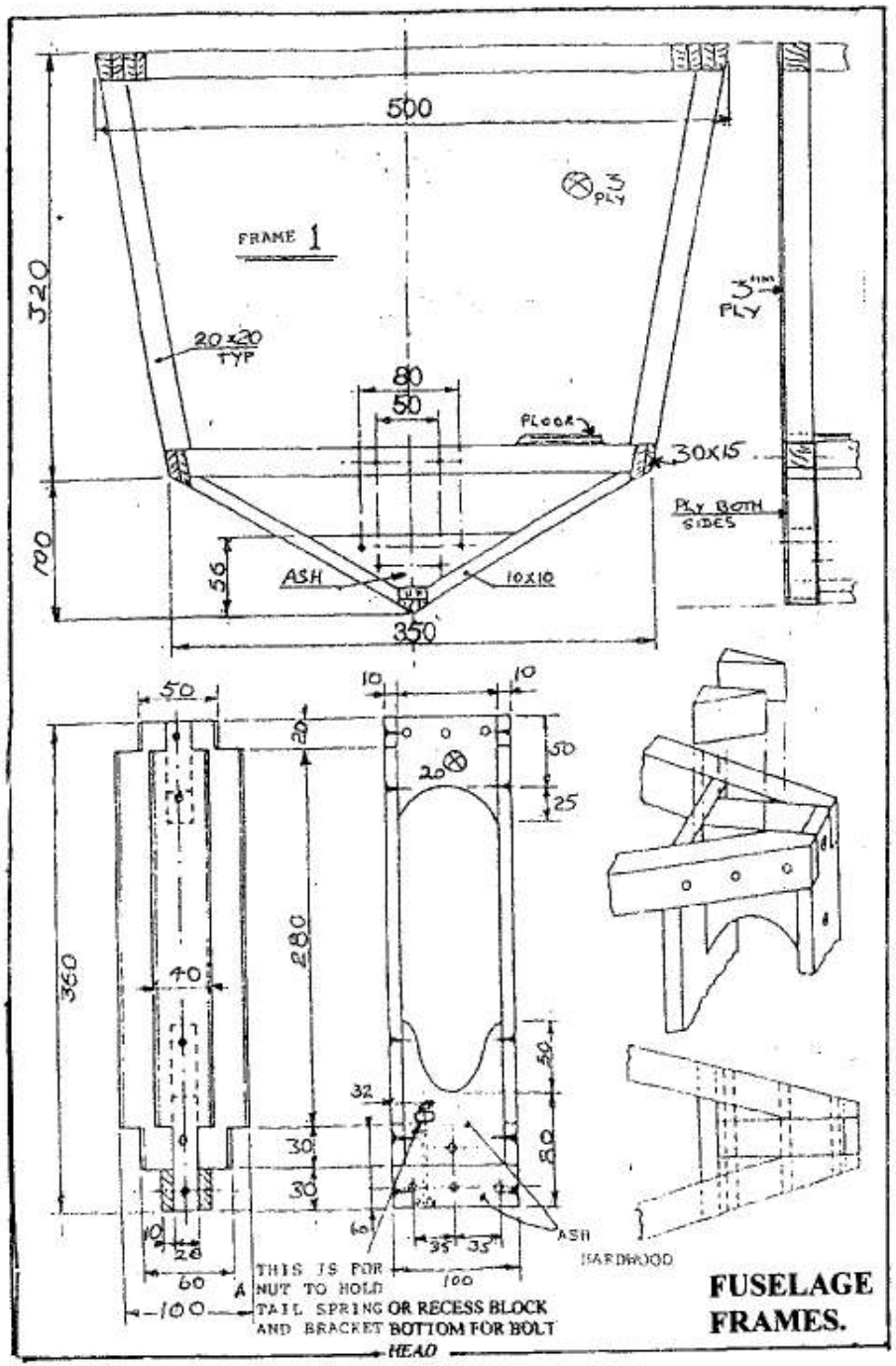
FUSELAGE SMALL PILOTS.


THIS PROFILE AND DIMENSIONS WILL DEPEND ON MOTOR AND COWL INSTALATION
LAMINATE LONGERONS MAKE CONSTRUCTION SIMPLER
SEE NOTE DRG 1 REGARDING LONGERON EXTENSION
note. The 100mm vertical member shown on drg. 2 bottom L.H. corner will vary in width if you change the length of the fuselage
TEMPORY CROSS MEMBER
3mm Ply
2 - 20x20 OR 4 - 20x10
20x20 TYP
IF FRAMES ARE TAPERED THIS MEMBER IS CURVED
6mm Ply
3mm Ply
10x10
ASH BLOCKS
LOCKER
30x15 OR R - 30x7.5
20x20 OR 2-20x10
2-20x10 OR 1 - 20x20
500
700
250
1100 *
2550
IF ALUM OR R.G.F. SEAT IS FITTED SEAT ATTATCHMENT WIL NEED TO BE LOWERED
FRAME 1
NOTE. REMEMBER WHEN LAYING OUT THE LONGERONS THAT IF YOU ARE POSITIONING THE REAR WING BACK AS IN DRG 1A, TO KEEP THE CORRECT ATTATCHMENT HOLE HOLE DIMEN FOR FOR FRONT AND REAR SPAR THAT IS 520 and 320 SEE DRG 19 FOR ALT REAR SPAR FITTING
NOTE. HM 290 /293 FUSELAGE SIDES MAY BE MADE VERTICLE NOT SLOPED THIS WILL SAVE CONSTRUCTION TIME. LAY OUT FRAMES OUTSIDE TO OBTAIN NEW DIMENTIONS
OTHER CHANGES. CONTROL TUBE WILL BE LONGER (DRG 1)
OUTLETS ON FUSELAGE SIDES - PLATES FITTED SQUARE NOT SLOPED
CABANE PICKUP MADE 90° (DRG 5)
TOP AND BOTTOM LONGERONS WILL BE AT 90° EXCEPT V BOTTOM
NOTE SEE 56

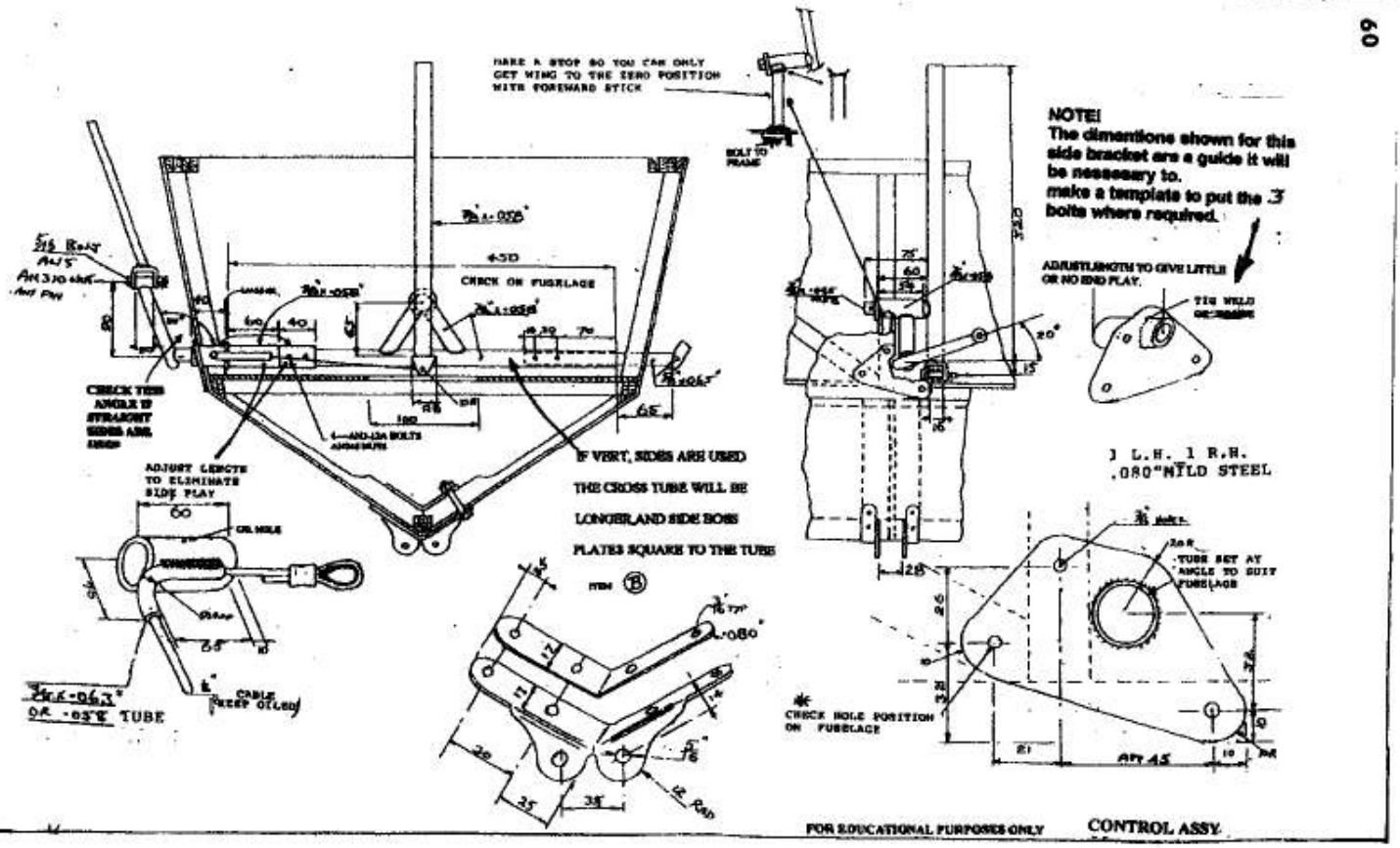
FUSELAGE LARGER PILOTS.



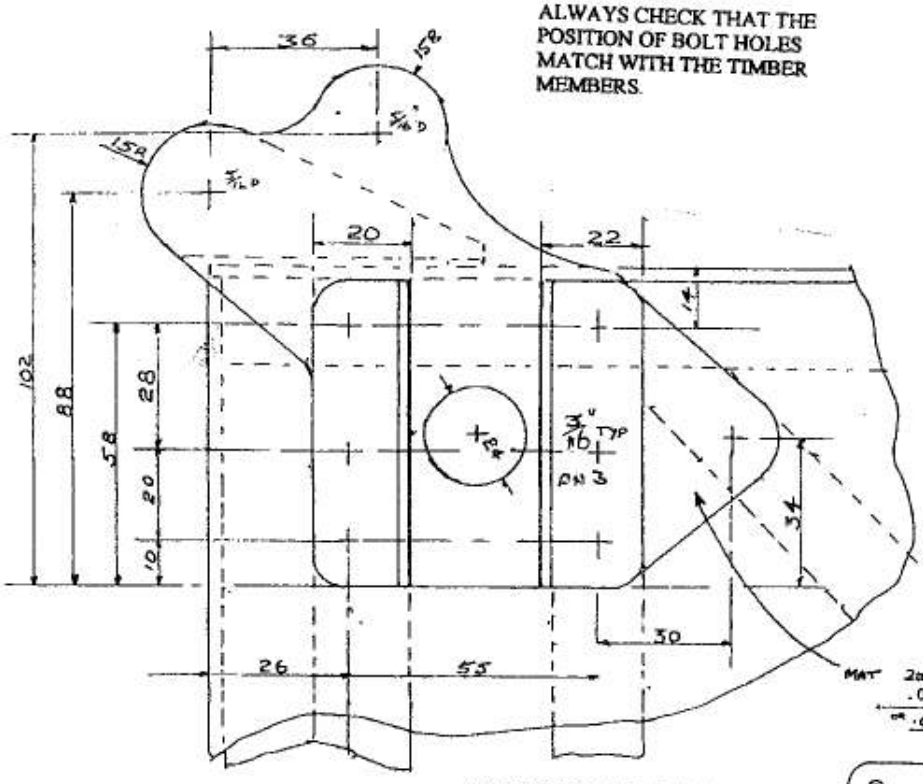
FUSELAGE FRAMES



FUSELAGE FRAMES.


MAKE A STOP SO YOU CAN ONLY GET WING TO THE ZERO POSITION WITH FORWARD STICK
BOLT TO FRAME
NOTE!
The dimentions shown for this side bracket are a guide it will be nessesary to.
make a template to put the 3 bolts where required.
ADJUST LENGTH TO GIVE LITTLE OR NO END PLAY.
TIG WELD
CHECK ON FUSELAGE
CHECK THIS ANGLE IF STRAIGHT SIDES ARE USED
ADJUST LENGTH TO ELIMINATE SIDE PLAY
IF VERT. SIDES ARE USED
THE CROSS TUBE WILL BE
LONGER AND SIDE BOSS
PLATES SQUARE TO THE TUBE
ITEM B
CABLE KEEP OILED
OR .035" TUBE
1 L.H. 1 R.H.
.080" MILD STEEL
TUBE SET AT ANGLE TO SUIT FUSELAGE
CHECK HOLE POSITION ON FUSELAGE
FOR EDUCATIONAL PURPOSES ONLY
CONTROL ASSY.

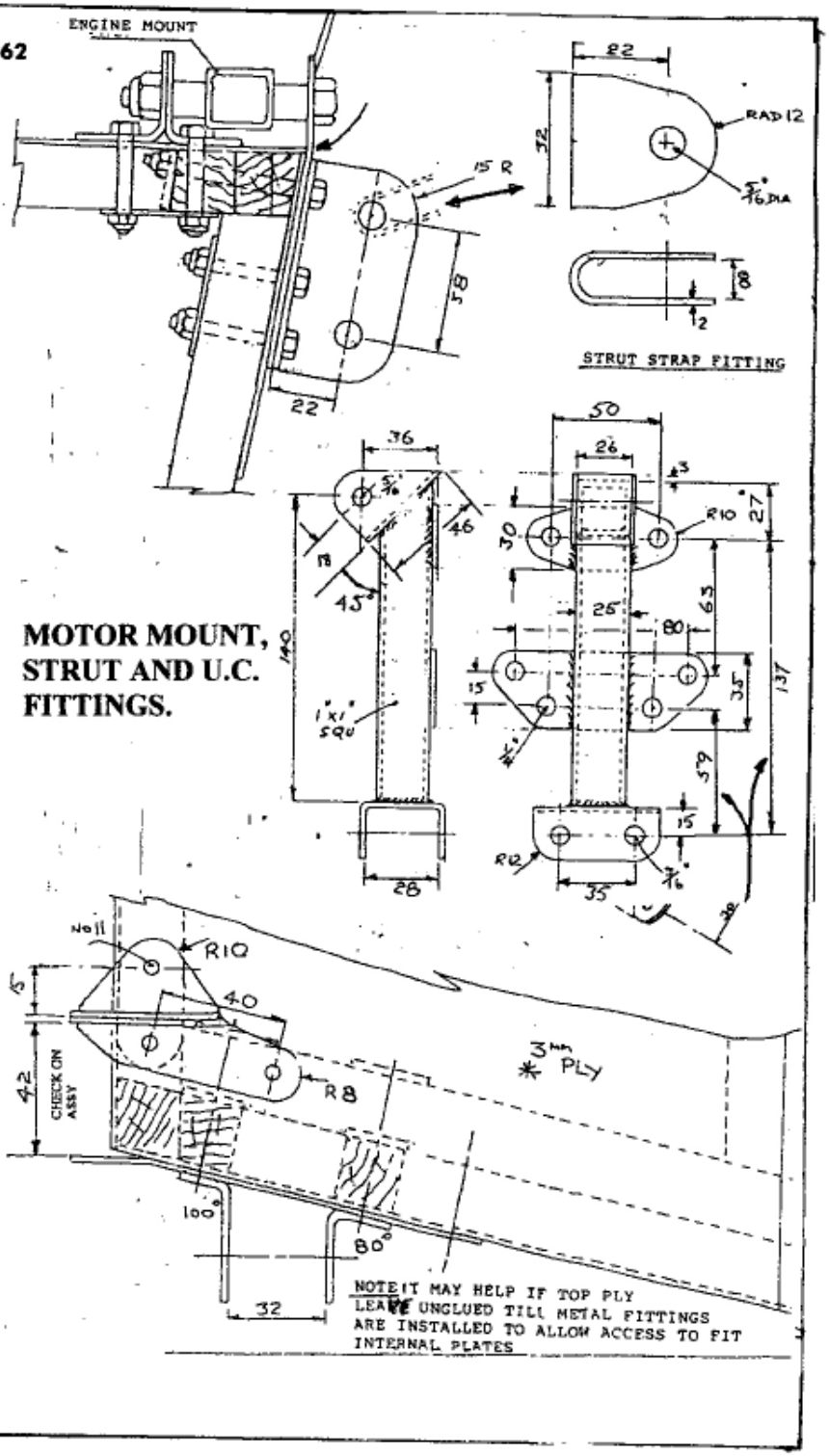
ALWAYS CHECK THAT THE POSITION OF BOLT HOLES MATCH WITH THE TIMBER MEMBERS.



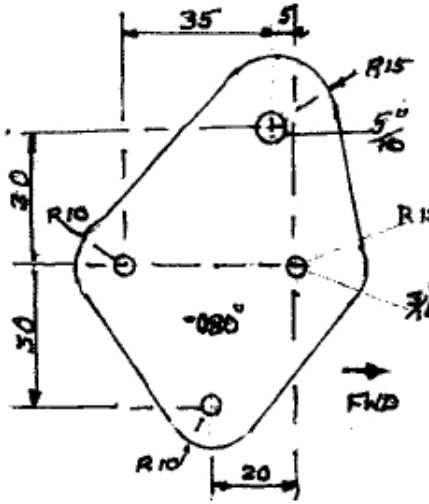
MAT 2mm MILD STEEL OR .063" 4130 Cond N
or .080"

ENGINE MOUNT. U.C, STRUT AND CABANE MOUNT.

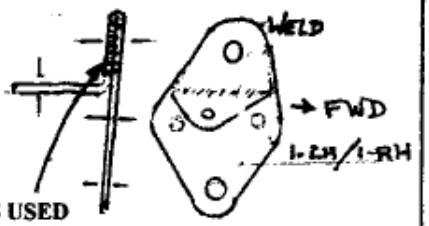
TYP NUT PLATE MAKE 1.5 or 2mm ST STEEL



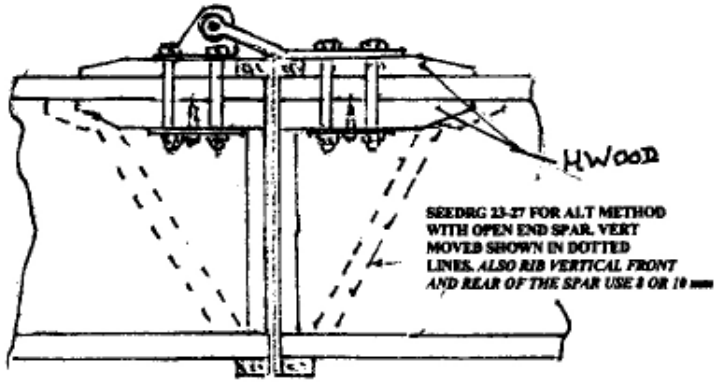
MOTOR MOUNT, STRUT AND U.C. FITTINGS.



REAR CABANE ATTACHMENT ON THE FUSELAGE.

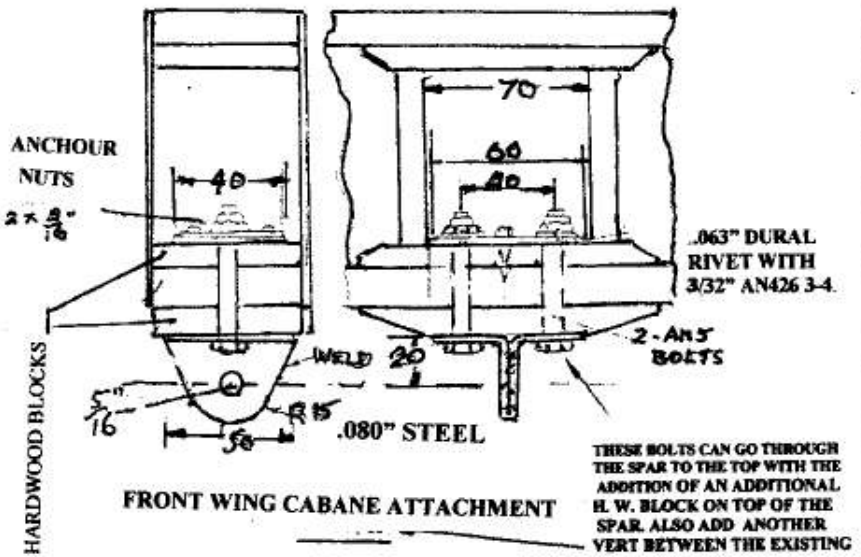


IF STRAIGHT SIDES USED THIS ANGLE IS 90 DEG
IF TAPERED IT'S 105 DEG
CHECK ON JOB.

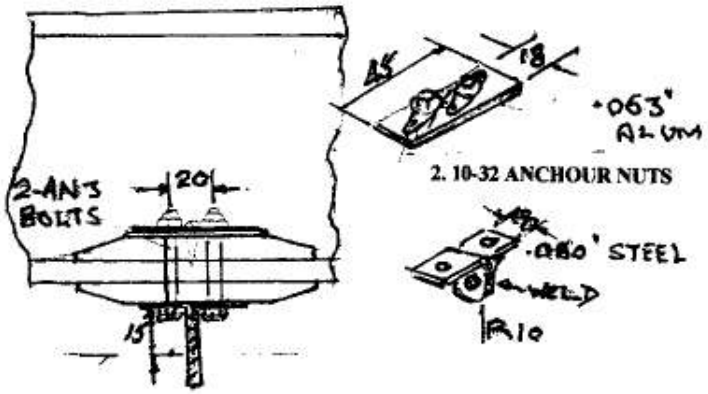

HWOOD
SEEDRG 23-27 FOR ALT METHOD WITH OPEN END SPAR. VERT MOVED SHOWN IN DOTTED LINES. ALSO RIB VERTICAL FRONT AND REAR OF THE SPAR USE 8 OR 10 mm

REAR SPAR HINGE ASSY

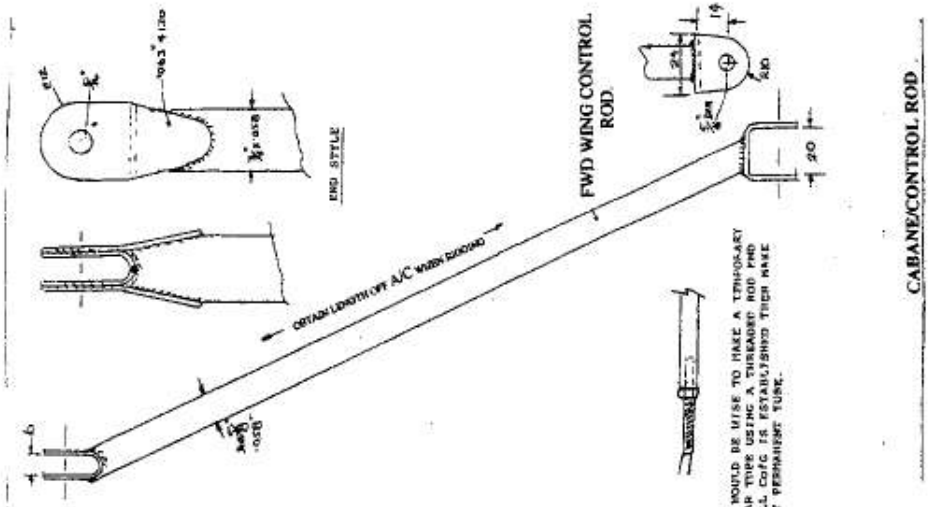
WING FITTINGS

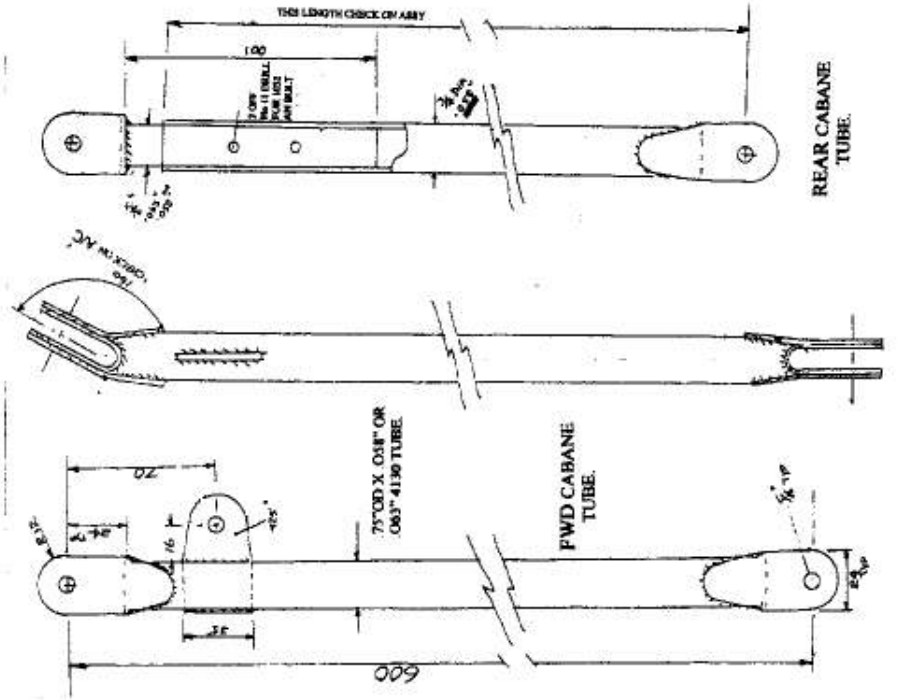


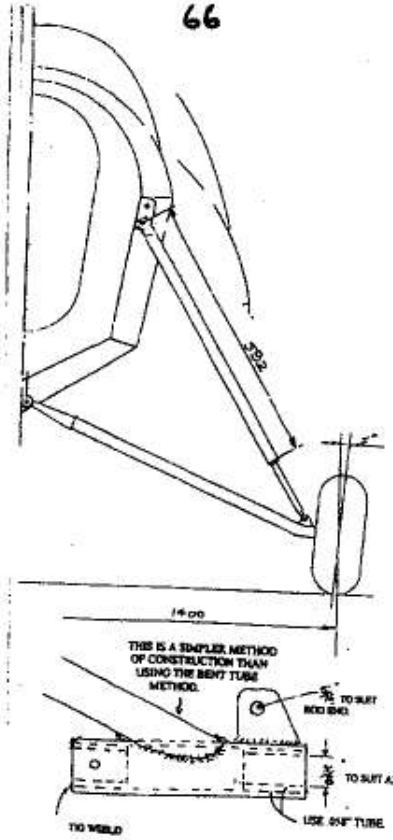
FRONT WING CABANE ATTACHMENT

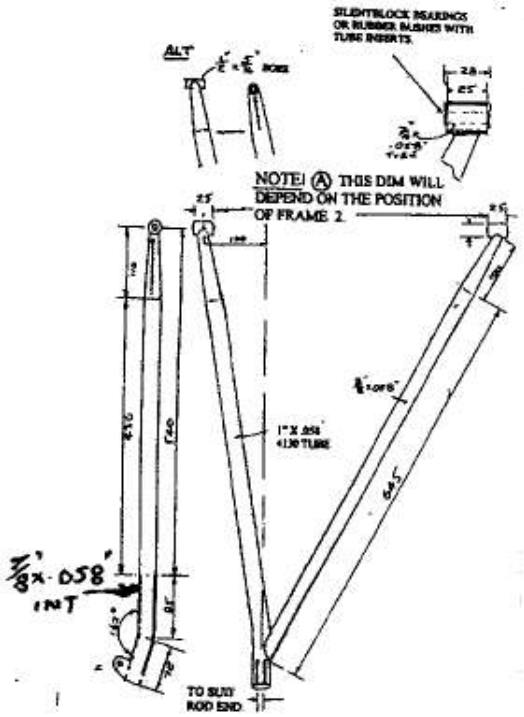


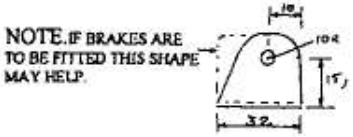
FRONT WING PUSH ROD, ATTACHMENT.

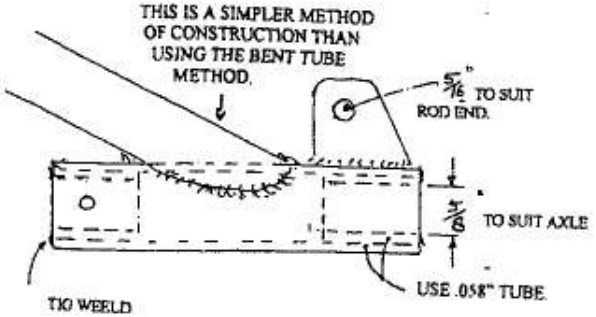

FWD WING CONTROL ROD.
CABANE/CONTROL ROD
END STYLE
OBTAIN LENGTH OFF A/C WHEN BUILDING
IT WOULD BE WISE TO MAKE A TEMPORARY REAR TUBE USING A TURNBUCKLE ROD END TILL C of G IS ESTABLISHED THEN MAKE THE PERMANENT TUBE.



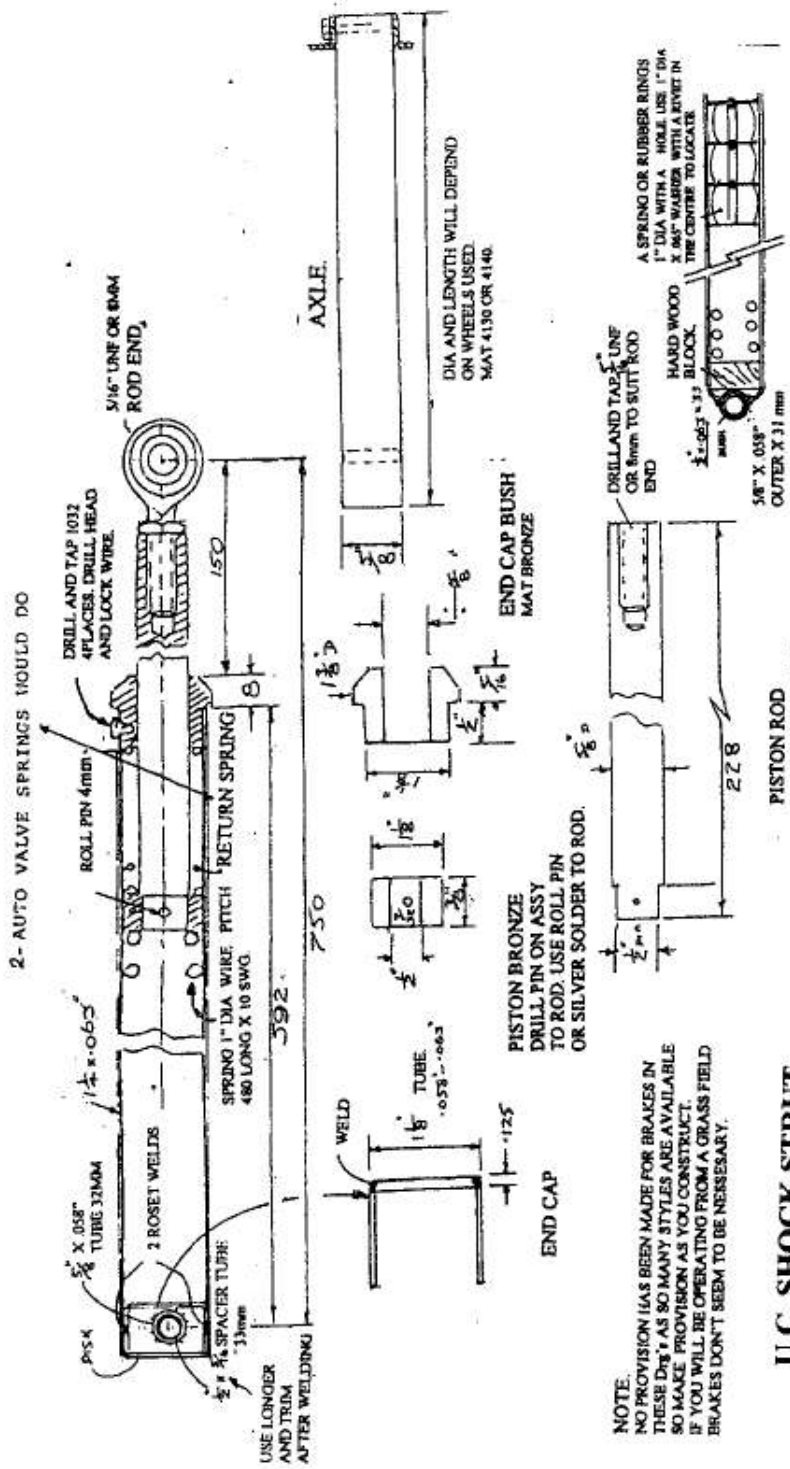



ALT
SILENTBLOCK BEARINGS OR RUBBER BUSHES WITH TUBE INSERTS.
NOTE! Ⓐ THIS DIM WILL DEPEND ON THE POSITION OF FRAME 2.
1" X .058" 4130 TUBE
5/8" X .058" INT
TO SUIT ROD END.




THIS IS A SIMPLER METHOD OF CONSTRUCTION THAN USING THE BENT TUBE METHOD.
TO SUIT ROD END.
TO SUIT AXLE
USE .058" TUBE.
TIG WEELD

ALT, LEG END.
THESE TUBE SIZES CAN BE CHANGED TO SUIT WHEEL AND AXLE SIZE.


2- AUTO VALVE SPRINGS WOULD DO
DRILL AND TAP 1032 4PLACES. DRILL HEAD AND LOCK WIRE.
5/16" UNF OR 8MM ROD END.
ROLL PIN 4mm
RETURN SPRING
SPRING 1" DIA WIRE, PITCH 480 LONG X 10 SWG.
2 ROSET WELDS
5/8" X .058" TUBE 32MM
SPACER TUBE 33mm
USE LONGER AND TRIM AFTER WELDING
392
750
150
AXLE.
DIA AND LENGTH WILL DEPEND ON WHEELS USED MAT 4130 OR 4140.
END CAP BUSH MAT BRONZE
PISTON BRONZE DRILL PIN ON ASSY TO ROD. USE ROLL PIN OR SILVER SOLDER TO ROD.
WELD
TUBE.
END CAP
DRILL AND TAP 5/16" UNF OR 8mm TO SUIT ROD END
A SPRING OR RUBBER RINGS 1" DIA WITH A HOLE LESS 1" DIA X .065" WASHER WITH A REVET IN THE CENTRE TO LOCATE
HARD WOOD BLOCK.
5/8" X .058" OUTER X 31 mm
228
PISTON ROD MAT 4130 OR 4140.

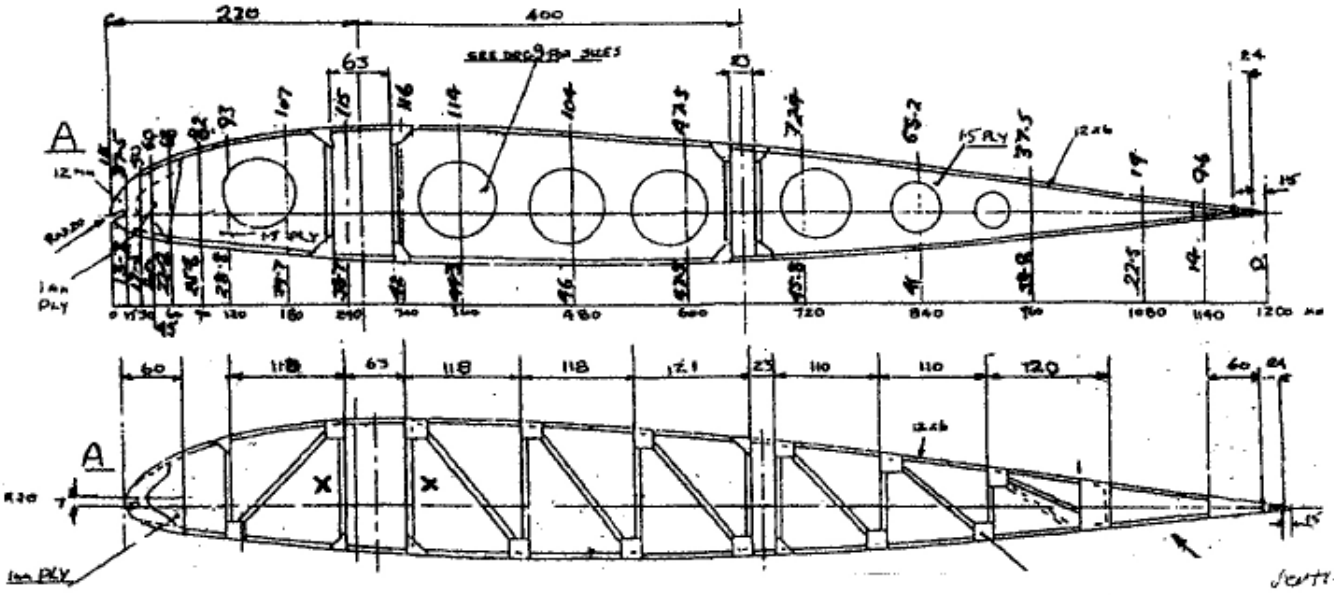
NOTE.
NO PROVISION HAS BEEN MADE FOR BRAKES IN THESE Dwg's AS SO MANY STYLES ARE AVAILABLE SO MAKE PROVISION AS YOU CONSTRUCT. IF YOU WILL BE OPERATING FROM A GRASS FIELD BRAKES DON'T SEEM TO BE NESSESARY.

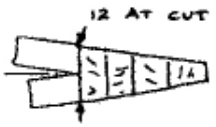
U.C. SHOCK STRUT.

WING ASSEMBLY

RIB A
400
230
+Y
-Y
X
GAP FOR "COSSANDEY" FLAP SPAR.
AT 3mm THICKNESS,
THEN 24mm FOR THE
TRAILING EDGE.
MAKE RIB B AND C IN A SIMILAR
WAY, REFER TO 'B' FOR CORDS
IF USING CENTRE RIBS JUST ADJUST THE
FWD AND REAR SECTION SPACING TO SUIT.
IN BETWEEN SPARS THE SAME, THAT IS 400mm
SPAR CENTRES FOR ALL RIBS.
LOOK AT RIBS, THERE ARE MORE DETAILED
DRAWINGS AT THE NOSE AREA WOULD BE TOO
CROWDED. THESE CAN BE ADDED WHEN MARKING
OUT FULL SIZE JIG.
TYPICAL GUSSET 25mm
GRAIN VERTICAL.
VARY TO SUIT TRIANGLE
GUSSETS.
MICRET 34.8.13 RIBS

SEE P 140





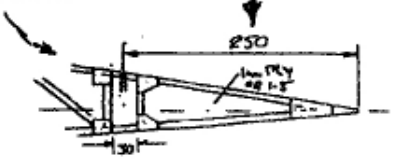
USE PLY FACED RIBS AT THE JOINT AREA, THIS *ALLOWS FOR BONDING* FABRIC. ONE EACH LEFT *AND RIGHT AT EACH* JOINT

*

NOTE.
FOR GIRDER TYPE SPACE **B & C** THE SAME AS **A** BETWEEN THE SPARS. ADJUST NOSE AND REAR AREA TO SUIT. USE PLY FACE ON RIB **B**

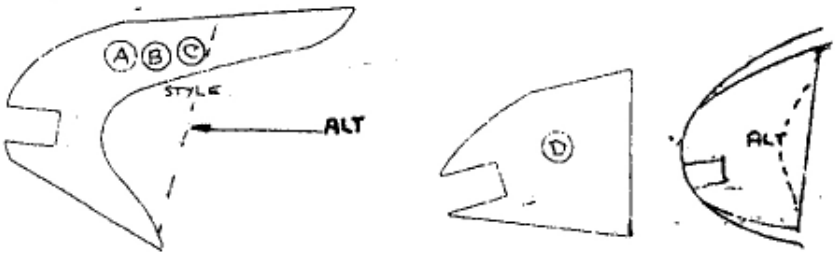
ADJUST YOUR JIG SO THE ADDITIONAL VERTICAL CAN *BE FITTED IF YOU ARE USING* THE "COSMANDEY" FLAP

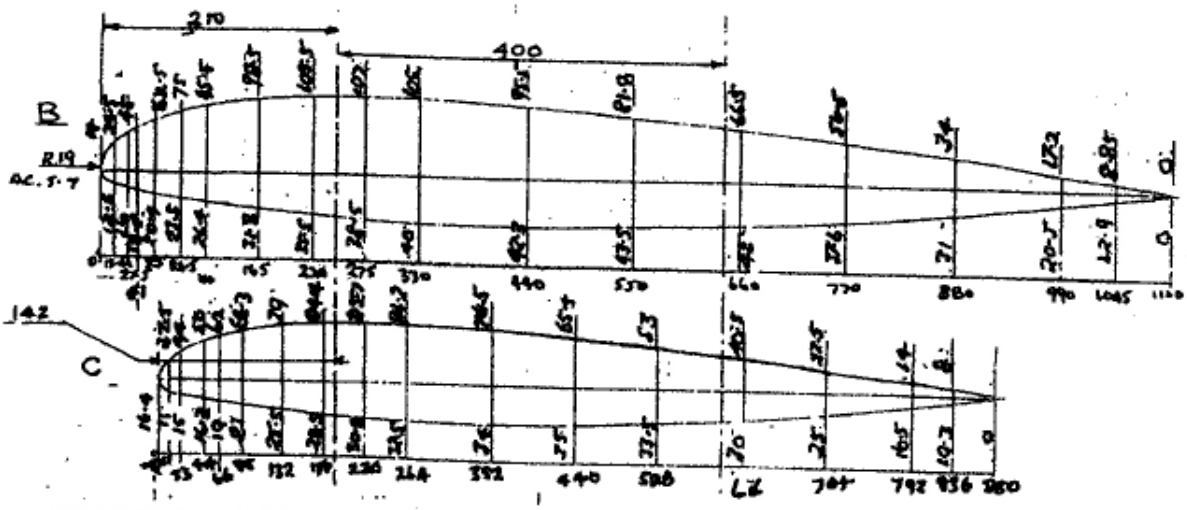
TO FIT "COSMANDEY" FLAP SOME **A** RIBS WILL NEED TO BE MODIFIED LIKE THIS.



USE PLY FACED RIBS AT THE FOLDING JOINT.

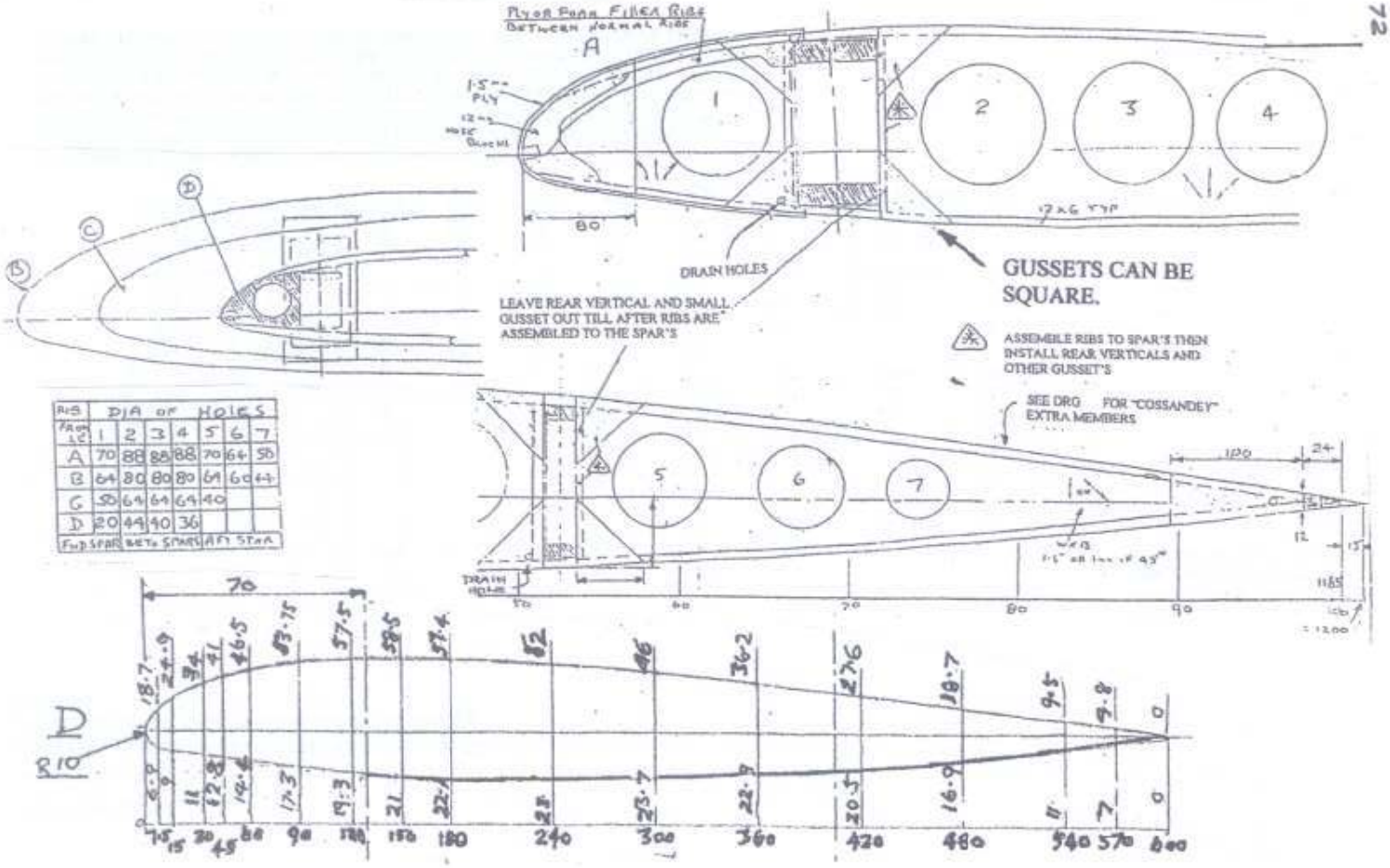
If you use the hinge type as shown in drg make the vertical members at the spar for joint ribs 10 or 12mm not 6mm. Make allowance in your jig for this.





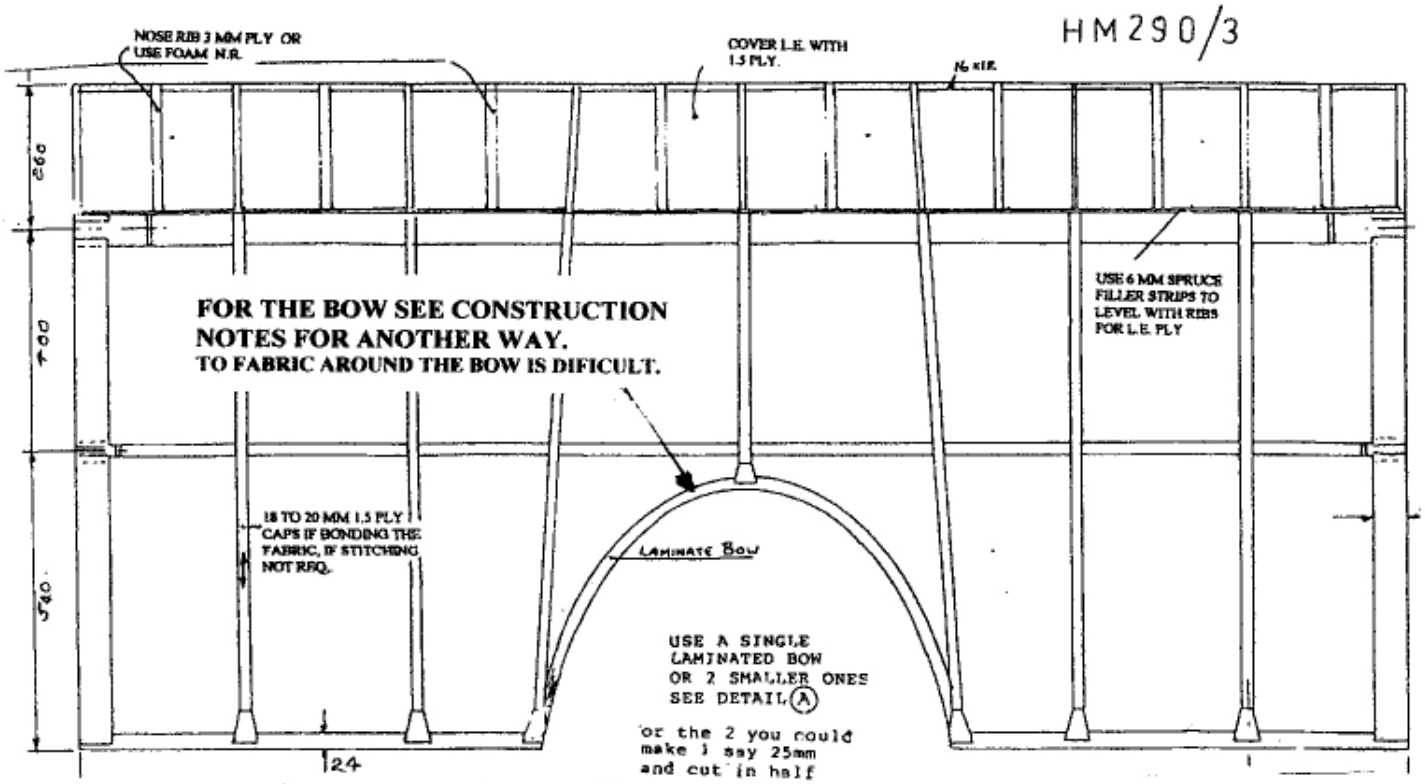
NOTE!
Spargap in rib B is 53mm
spar gap in rib C is 40mm
Spar gap in rib D is 32mm

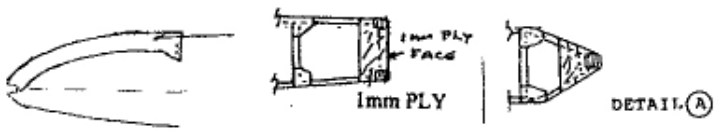
SEE DRG 9B FOR CORDS. I REALISE DIMENSIONS ARE HAIR SPLITTING, WE KNOW THE PEN IS THICKER, SO DO THE BEST YOU CAN. THE SPAR GAP IS SUCH FOR A SPAR THAT IS TAPERED FRONT AND BACK AT THE WING TIP SECTION. IF YOU WISH TO TAPER THE REAR ONLY YOU WILL NEED TO ADJUST THE GAPS ON B-C-D RIBS. WHEN MARKING OUT THE PROFILE (SEE DRG 9B) AND AT THE NOSE AREA YOU WILL FIND SMALLER INCREMENTS THAT CAN NOT BE SHOWN ON THE DRG, THIS ALLOWS FOR A FREE HAND CURVE SHAPE.



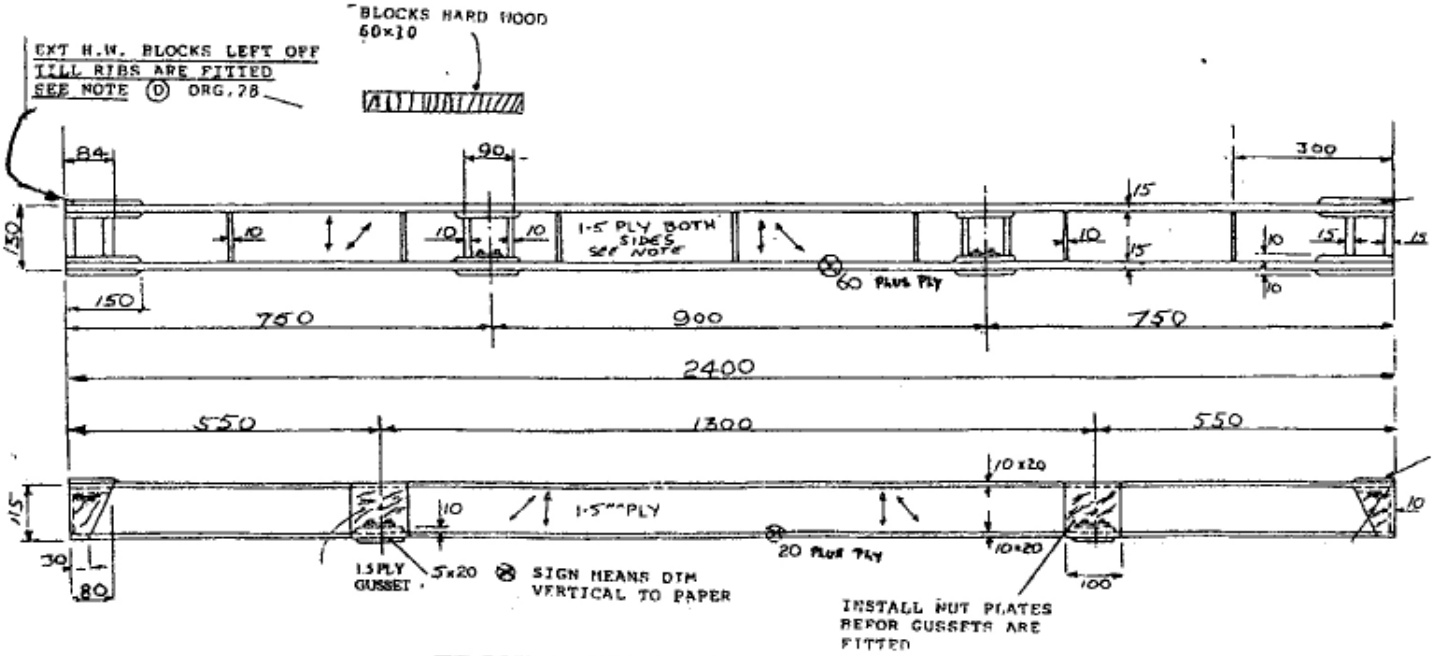
RIB	DIA OF HOLES						
AREA	1	2	3	4	5	6	7
A	70	88	88	88	70	64	56
B	64	80	80	80	64	60	48
C	56	64	64	64	40		
D	20	44	40	36			

FWD SPAR BETWEEN SPARS AFT SPAR


NOSE RIB 3 MM PLY OR USE FOAM N.R.
COVER L.E. WITH 1.5 PLY.
N.R.
260
400
340
FOR THE BOW SEE CONSTRUCTION NOTES FOR ANOTHER WAY.
TO FABRIC AROUND THE BOW IS DIFICULT.
USE 6 MM SPRUCE FILLER STRIPS TO LEVEL WITH RIBS FOR L.E. PLY
18 TO 20 MM 1.5 PLY CAPS IF BONDING THE FABRIC, IF STITCHING NOT REQ.
LAMINATE BOW
USE A SINGLE LAMINATED BOW OR 2 SMALLER ONES SEE DETAIL (A)
or the 2 you could make 1 say 25mm and cut in half
124

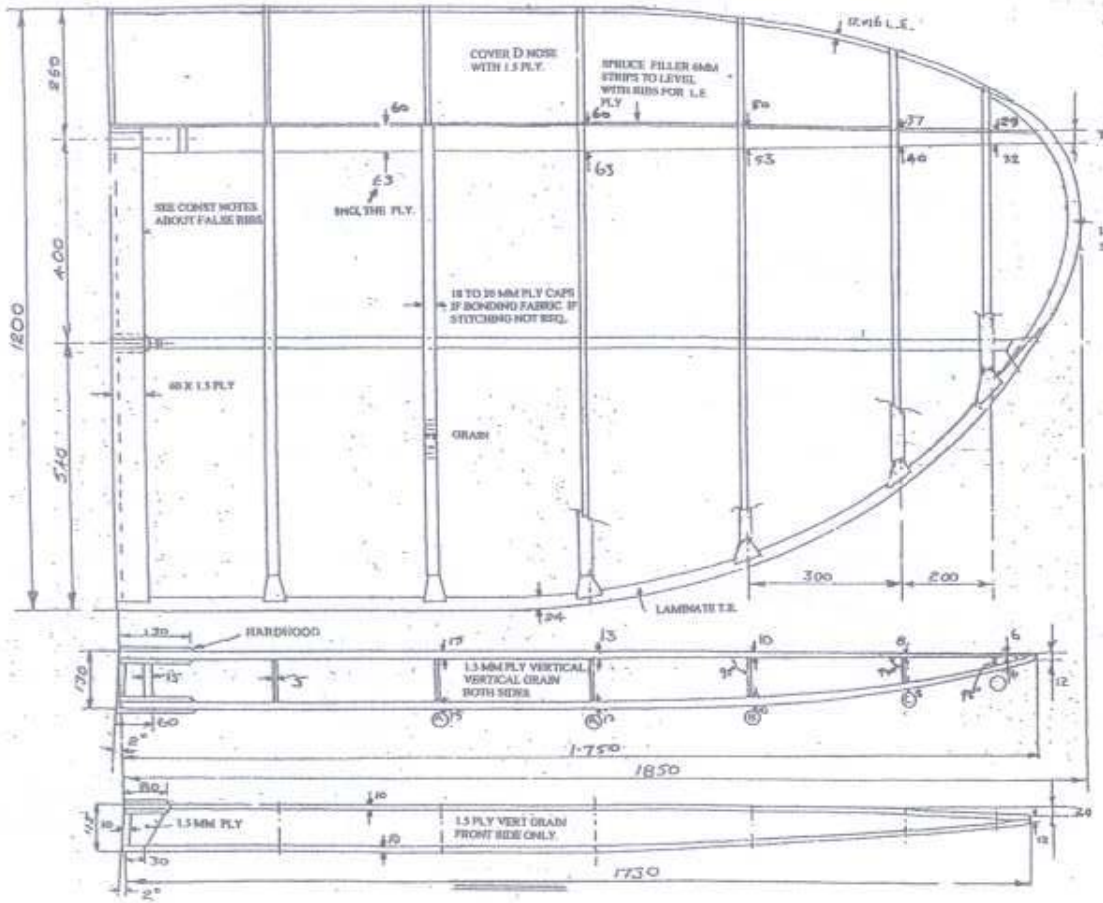


FRONT WING CENTER SECTION.

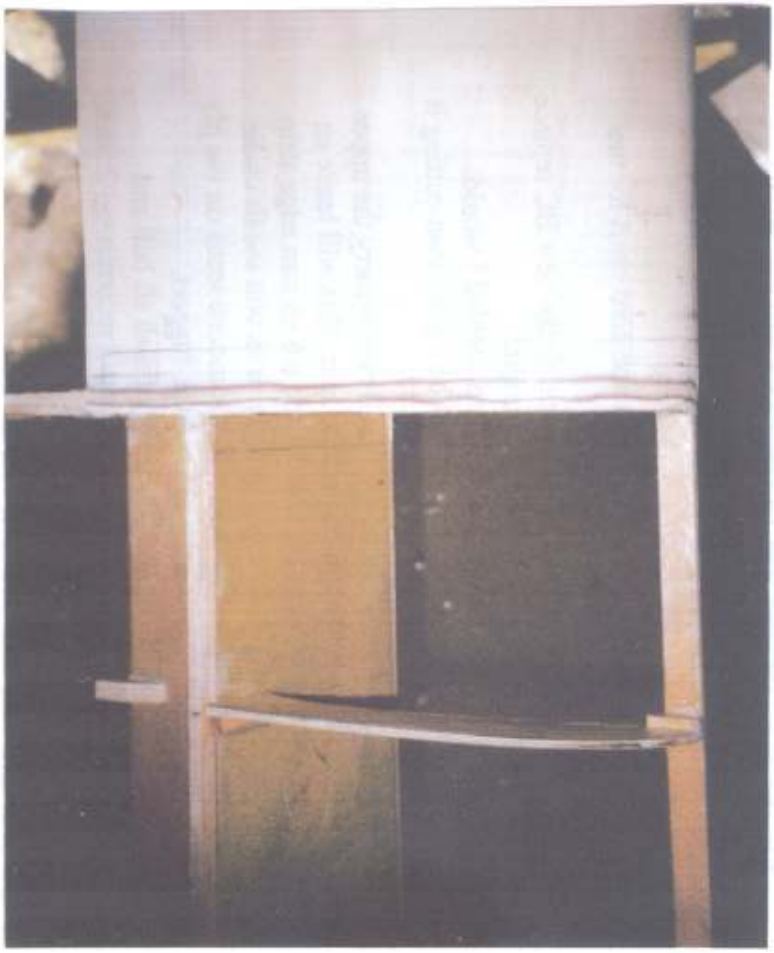


FRONT WING SPAR

LEAVE GUSSET OFF TILL NUT PLATES ARE INSTALLED AT TIME OF HINGE FITTING

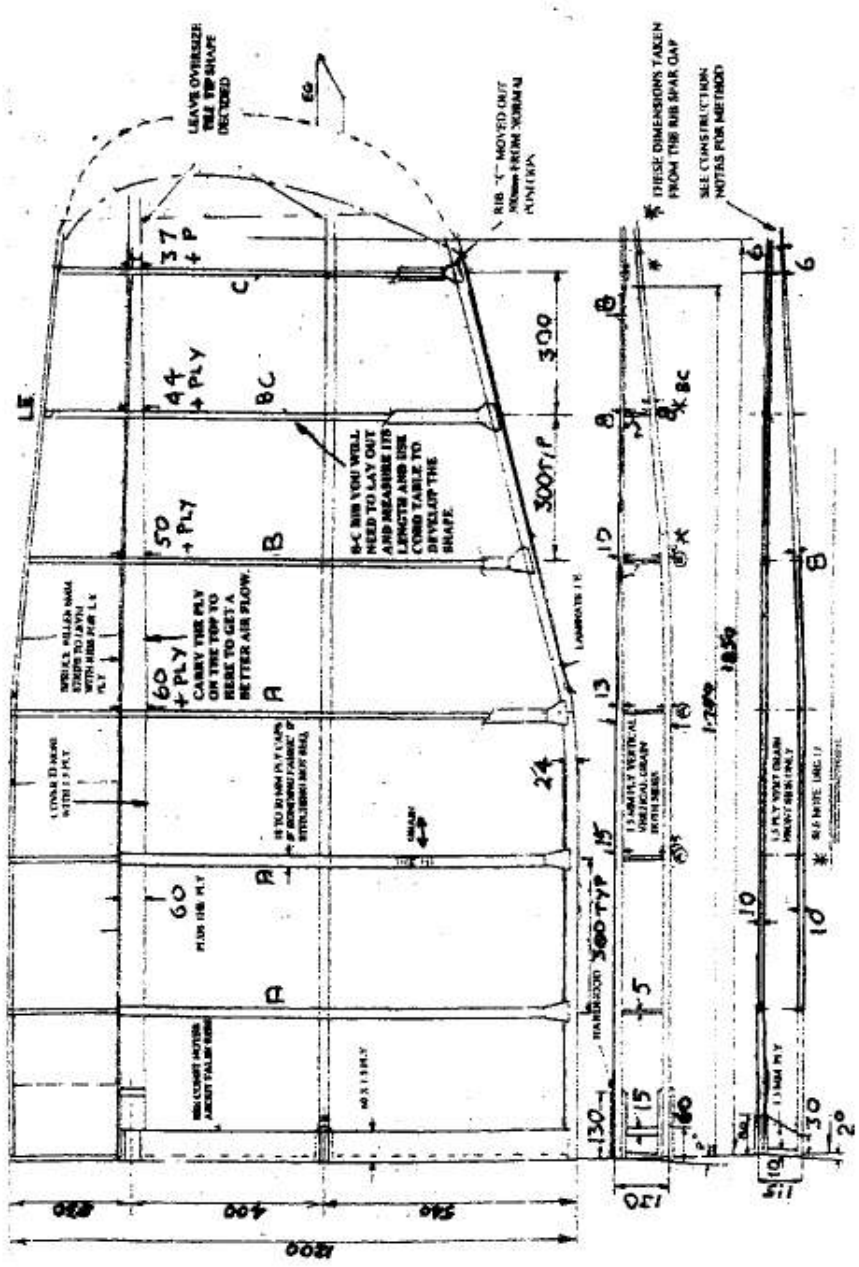


FRONT WING TIP.

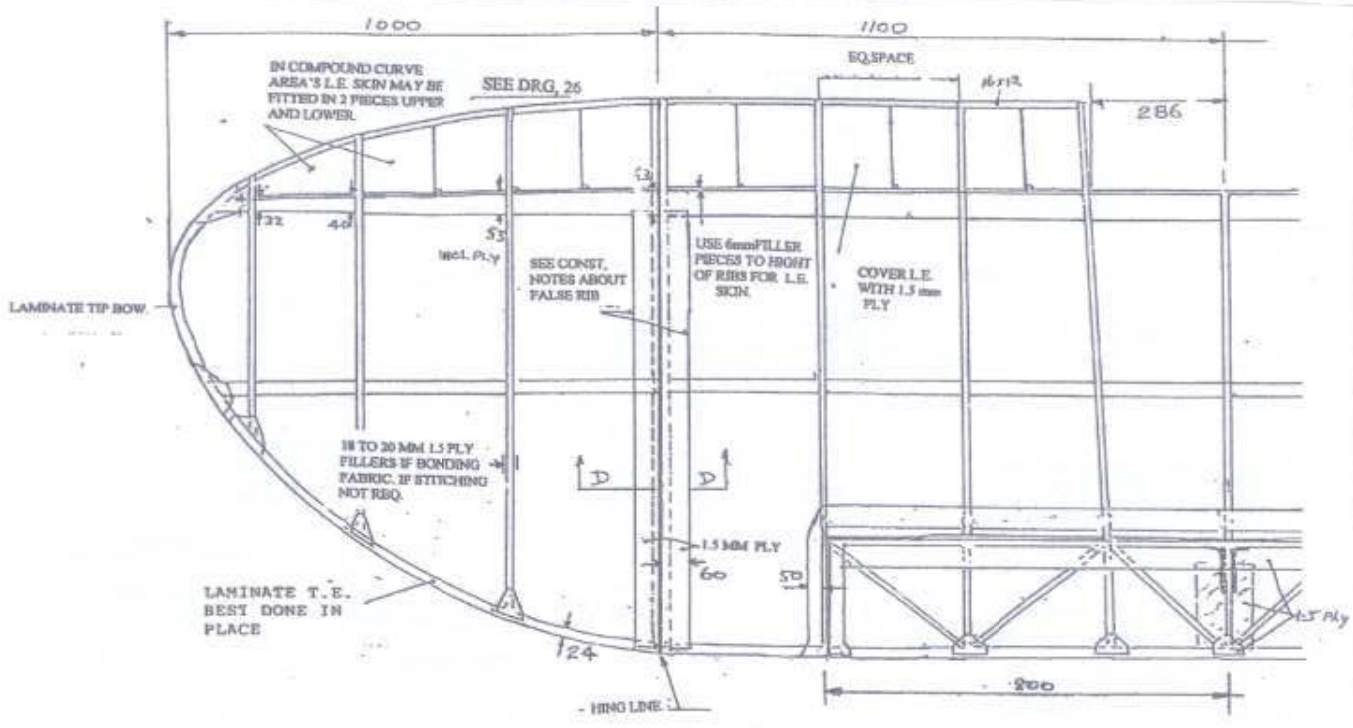


ALTERNATIVE WING TIP.
STRAIGHT TAPER.

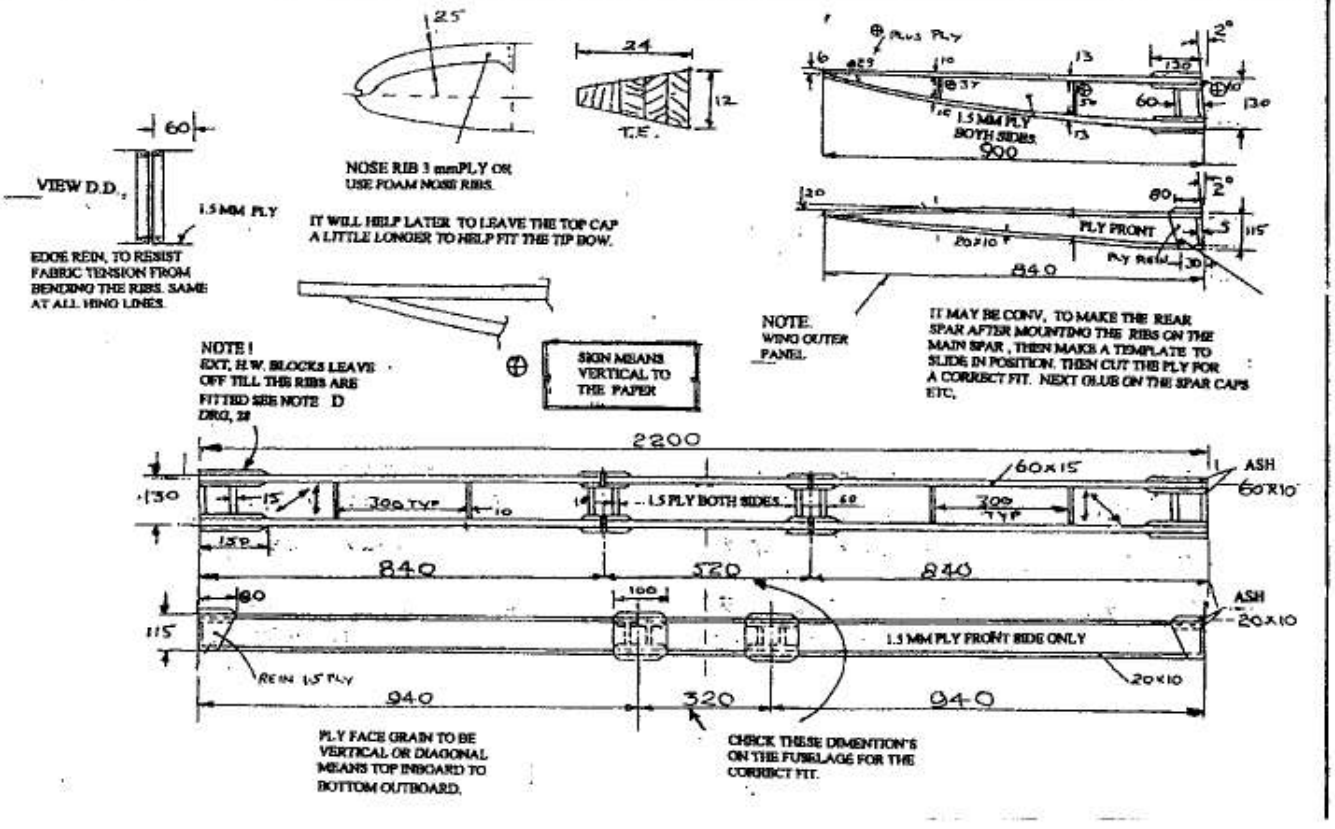
For those builders who do not like the idea of building elliptical wing tips they can produce this straight taper ends. If you look at Roy de Stadler's photo's you will see an example of it.
To find the length of the new rib BC as I have called it. This also will allow you to change the depth of the spar to suit. What this means is you will move the depth of the C rib position out to the D position and let the new BC depth will naturally develop.
If you decide to go this way it will pay to make the A –B –and C ribs. You can fit them onto your spar. That is the A and B can be glued or clamped. Fit the C rib in a place (No glue).
Now fit some LE member and TE so you can measure the length of what will become you new BC rib.
This will give you the cord line length to use to develop the rib profile.
You multiply the cord by the no's given in the cord chart for the Mignet 34.0.13 airfoil.
Do only make one rib, remove the C rib and fit the new BC replace the C rib and check the LE and TE are straight.
You can develop a suitable tip shape. When decided I would suggest you laminate a tip bow which will be lighter than cutting it from plywood.
One more point, as shown elsewhere it will pay to carry the upper ply back to level or say 10mm behind the spar. This will leave an unsupported edge which can buckle. So add a 6 x6 mm edge strip under it. Also put, say, a piece of 3mm ply or as you see fit under each end of this member. The reason is if someone leans on the ply it could cause a split between the ply and the support.
Do not forget before adding the D nose ply finish all bolt and support blocks etc and add protective coating. I recommend 2 pack Epoxy made from lay up resin.



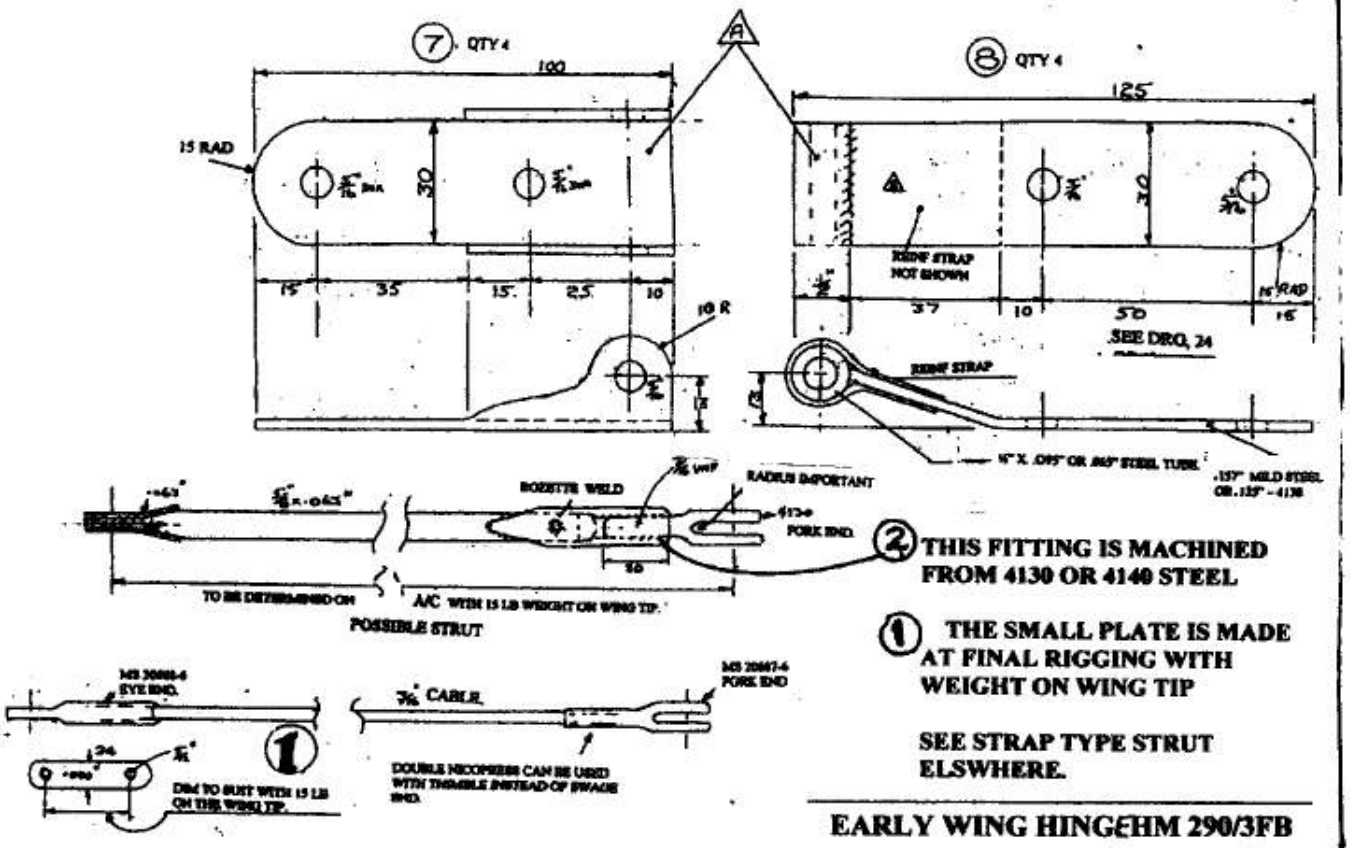
ALTERNATE WING TIP SHAPE


1000
1100
EQ SPACE
286
IN COMPOUND CURVE AREA'S L.E. SKIN MAY BE FITTED IN 2 PIECES UPPER AND LOWER.
SEE DRG. 26
SEE CONST. NOTES ABOUT FALSE RIB
USE 6mm FILLER PIECES TO HIGHT OF RIBS FOR L.E. SKIN.
COVER L.E. WITH 1.5 mm PLY
LAMINATE TIP BOW
18 TO 20 MM 1.5 PLY FILLERS IF BONDING FABRIC. IF STITCHING NOT REQ.
1.5 MM PLY
LAMINATE T.E. BEST DONE IN PLACE
HINGE LINE
200

REAR WING ASSEMBLY.


NOSE RIB 3 mmPLY OR USE FOAM NOSE RIBS.
IT WILL HELP LATER TO LEAVE THE TOP CAP A LITTLE LONGER TO HELP FIT THE TIP BOW.
VIEW D.D.
1.5 MM PLY
EDGE REIN, TO RESIST FABRIC TENSION FROM BENDING THE RIBS. SAME AT ALL WING LINES.
NOTE.
WING OUTER PANEL
IT MAY BE CONV. TO MAKE THE REAR SPAR AFTER MOUNTING THE RIBS ON THE MAIN SPAR, THEN MAKE A TEMPLATE TO SLIDE IN POSITION. THEN CUT THE PLY FOR A CORRECT FIT. NEXT GLUB ON THE SPAR CAPS ETC.
NOTE!
EXT. H.W. BLOCKS LEAVE OFF TILL THE RIBS ARE FITTED SEE NOTE D DRG. 28
SIGN MEANS VERTICAL TO THE PAPER
2200
60x15
ASH
60x10
1.5 PLY BOTH SIDES
300 TYP
840
320
840
ASH
20x10
1.5 MM PLY FRONT SIDE ONLY
REIN 1.5 PLY
940
320
940
PLY FACE GRAIN TO BE VERTICAL OR DIAGONAL MEANS TOP INBOARD TO BOTTOM OUTBOARD.
CHECK THESE DIMENTION'S ON THE FUSELAGE FOR THE CORRECT FIT.

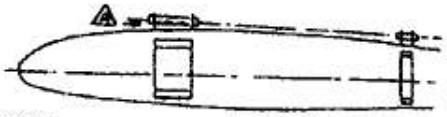
REAR WING SPAR AND TIP



EARLY WING HINGEHM 290/3FB

WING FITTINGS

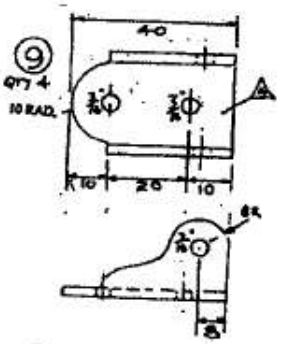
FITTINGS (7) AND (8) (9) (10) ARE MOUNTEDON WEDGE PLATES TO ALIGN WITH EACH OTHER. SEE ALIGNMENT ROD.

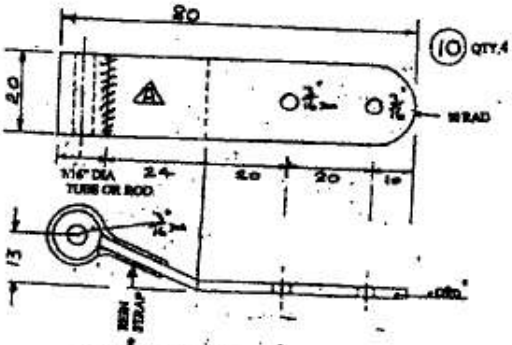


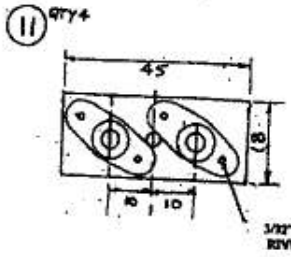
NOTE

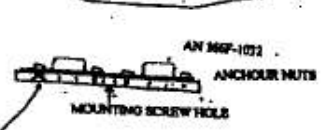
(A) IT IS REQ. TO VARY THE ANGLE OF THE VERTICAL ON ITEM'S 7 & 9 AND PIVOT BOLT HOLES TO MAINTAIN A STRAIGHT LINE BETWEEN THE HINGES SO THE WING WILL FOLD WITHOUT TWISTING THE HINGES. ITEM 8 & 10 NEED A SLIGHT TWIST TO MATCH 7 & 9. OR YOU CAN TAPER THE ASH BLOCK OR ADD THIN WEDGES SEE DWG 29, 28

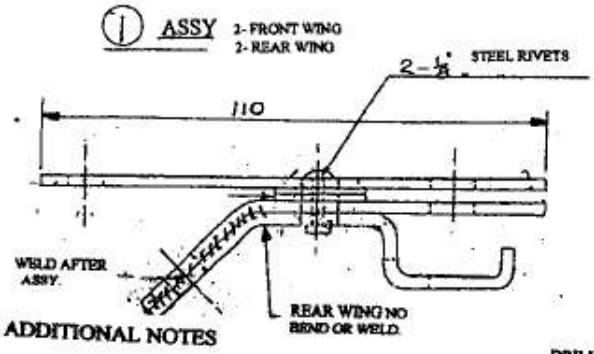
P III



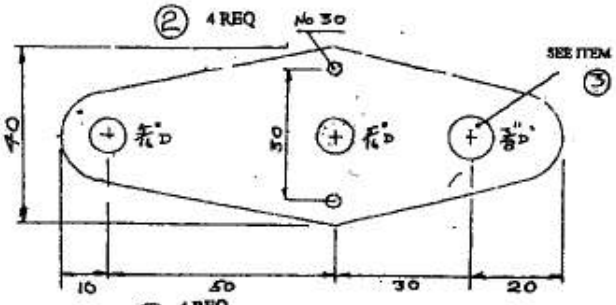


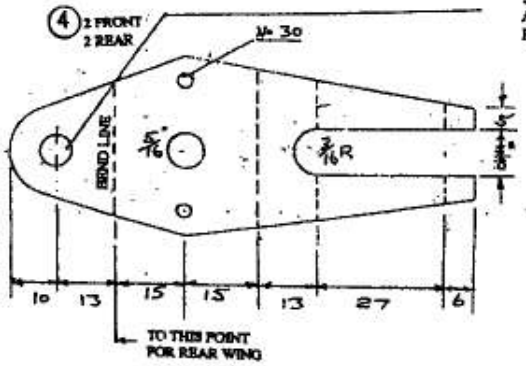


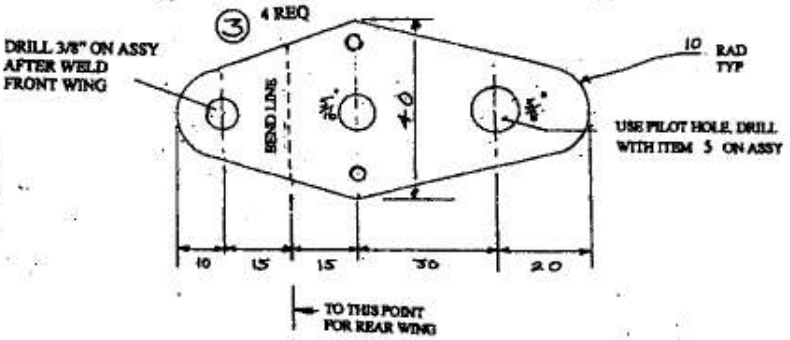




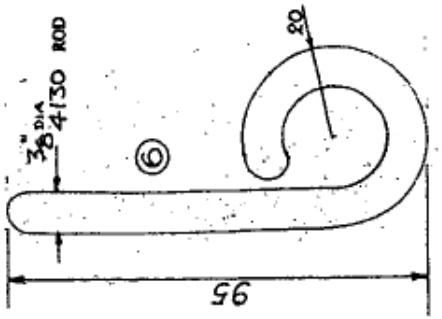
SEE ADDITIONAL NOTES







WING FITTINGS.



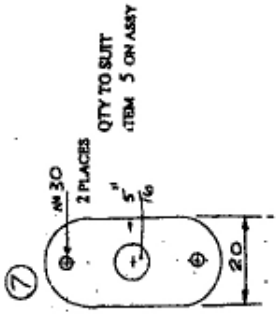
NOTE.

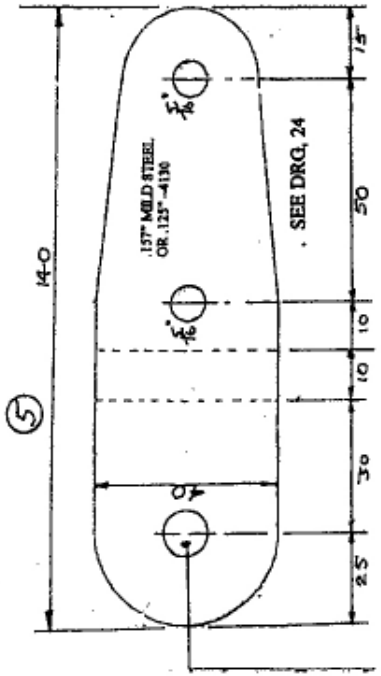
1. WHEN THE WING IS IN THE FLYING POSITION ITEM ⑤ SLIDES BETWEEN ② AND ③ AND ITEM ⑥ INSERTED

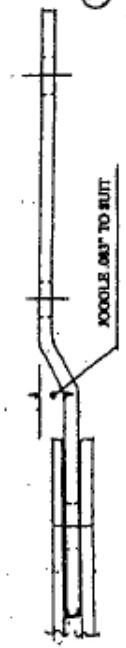
2. ITEM ②③④⑦ MADE FROM .080" ANNEALED STEEL OR 4130 .063"

3. REAR WING FITTINGS ARE THE SAME EXCEPT "FOR STRUT OR CABLE LUG. SEE DRG, 14

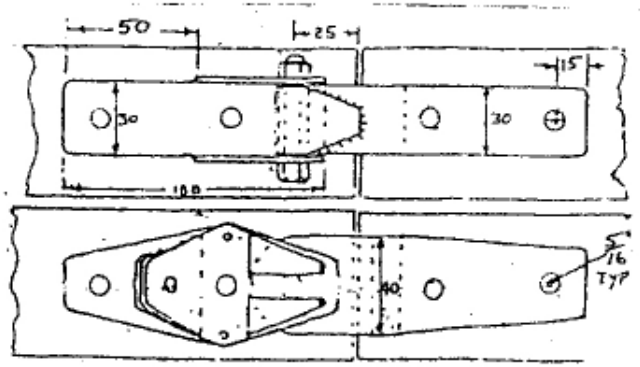
SEE DRG, 9 FOR SIZES

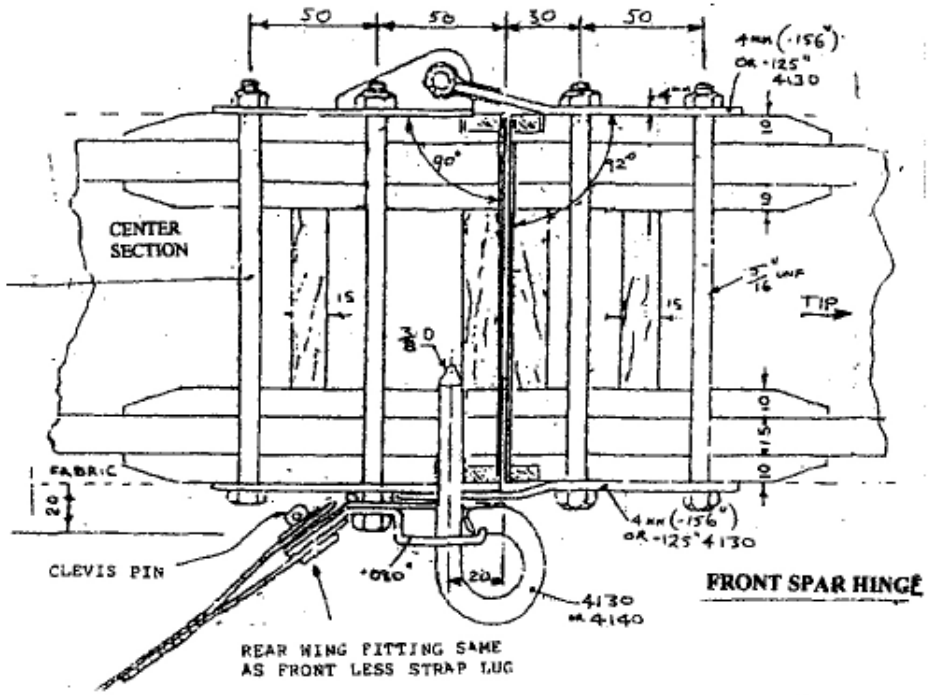






BOLT ASSY TO WING



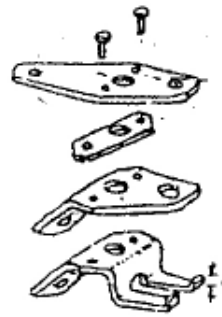


FRONT SPAR HINGE

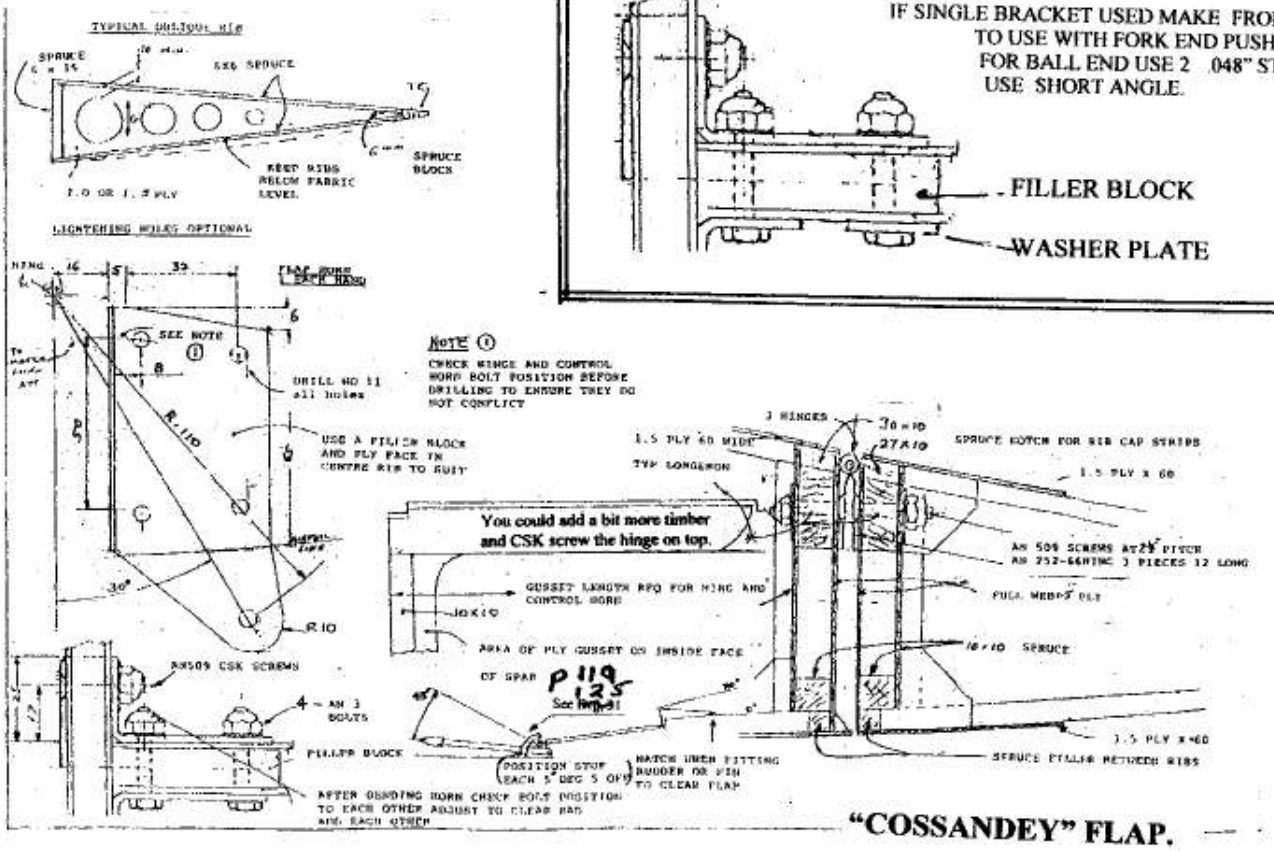
REAR WING FITTING SAME
AS FRONT LESS STRAP LUG

5/16" UNF BOLTS
AN-5 OR 4130 ROD
THREAD BOTH ENDS
PLAIN SHANK MUST
ENTER FITTINGS BOTH
TOP AND BOTTOM

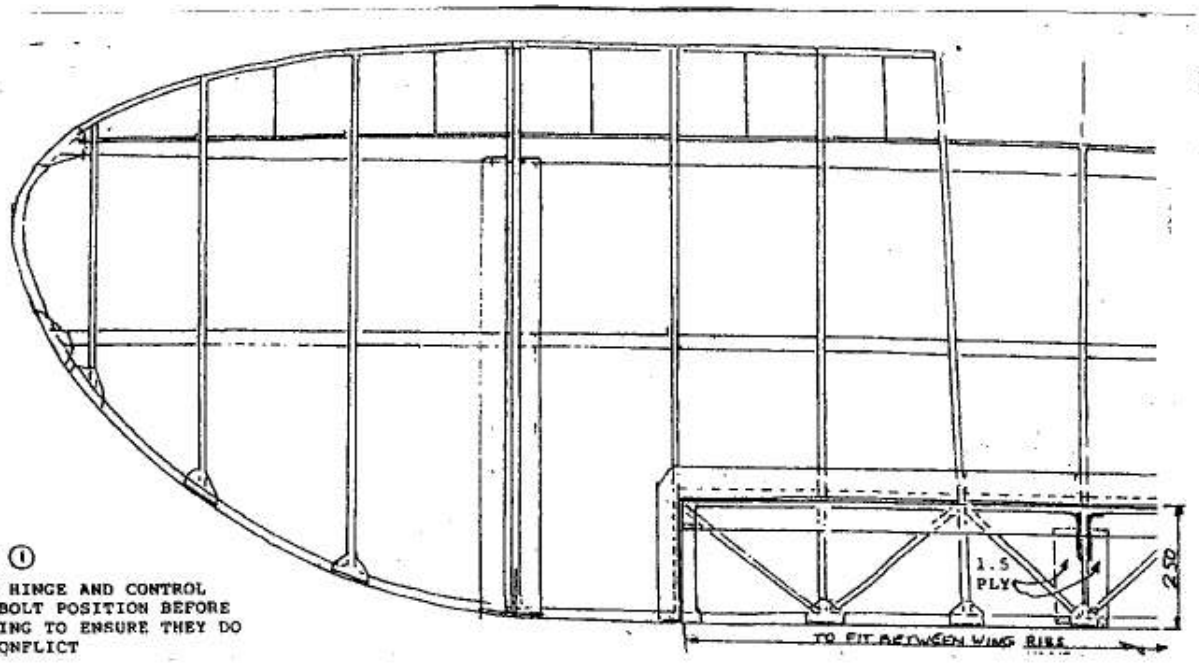
USE WASHERS AS REQ



WHEN MAKING THESE FITTINGS POSITION HING BOLT HOLES SO AS TO ALIGN BOTH FRONT AND REAR AXIS. TIP FITTING MAY NEED TO BE TWISTED A LITTLE OR WEDGES CAN BE USED TO ALIGN AXLE BOLT.

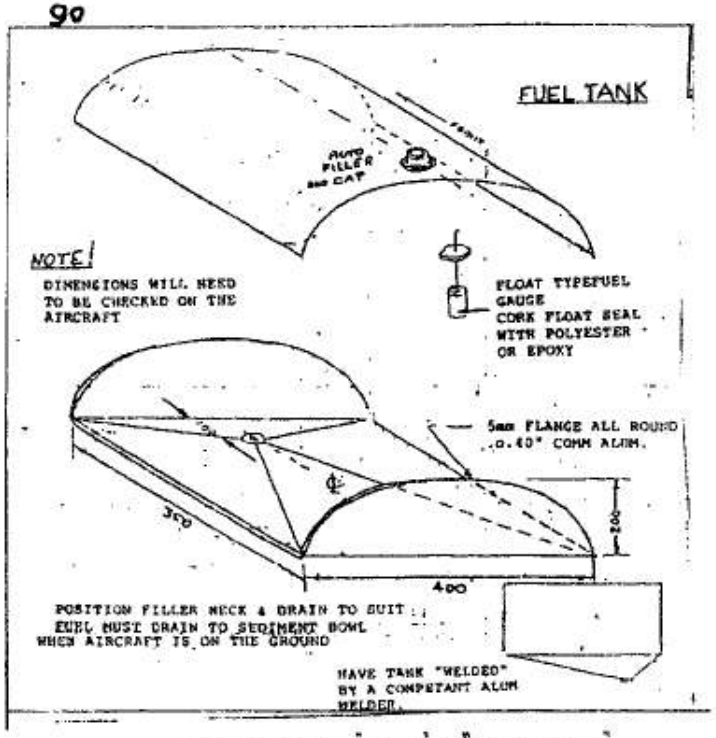

IF SINGLE BRACKET USED MAKE FROM .063"
TO USE WITH FORK END PUSH ROD.
FOR BALL END USE 2 .048" STEEL.
USE SHORT ANGLE.
FILLER BLOCK
WASHER PLATE
TYPICAL MULTIPLE RIB
SPRUCE
SEE SPRUCE
SPRUCE BLOCKS
KEEP RIBS BELOW FABRIC LEVEL
7.0 OR 1.5 PLY
LIGHTENING HOLES OPTIONAL
HINGE
SEE NOTE ①
DRILL NO 11 all holes
USE A FILLER BLOCK AND PLY FACE IN CENTRE RIB TO SUIT
R.110
R.10
30°
AN509 CSK SCREWS
4 - AN 3 BOLTS
FILLER BLOCK
Note ①
CHECK HINGE AND CONTROL HORN BOLT POSITION BEFORE DRILLING TO ENSURE THEY DO NOT CONFLICT
You could add a bit more timber and CSK screw the hinge on top.
GUSSET LENGTH REQ FOR HINGE AND CONTROL HORN
10X10
AREA OF PLY GUSSET ON INSIDE FACE OF SPAR
P 119 125
See Page 81
POSITION STOP EACH 5° DEG 5 OFF
MATCH UNDER FITTING RUDDER OR FIN TO CLEAR FLAP
AFTER GRINDING HORN CHECK BOLT POSITION TO EACH OTHER ADJUST TO CLEAR RAD AND EACH OTHER
3 HINGES
1.5 PLY 60 WIDE
TYP LONGERON
SPRUCE GUSSET FOR RIB CAP STRIPS
1.5 PLY X 60
AN 509 SCREWS AT 2" PITCH
AN 752-66 NUTS 3 PIECES 12 LONG
FUEL MEDIUM PLY
10 x 10 SPRUCE
1.5 PLY X 60
SPRUCE FILLER BETWEEN RIBS

"COSSANDEY" FLAP.


Note ①
CHECK HINGE AND CONTROL HORN BOLT POSITION BEFORE DRILLING TO ENSURE THEY DO NOT CONFLICT
1.5 PLY
TO FIT BETWEEN WING RIBS

IF REAR WING SET BACK AND LE IS FILLED IN ANGLED RIB WILL BE STRAIGHT.

"COSSANDEY" FLAP. AND INSTALATION. HM290/3 FB


FUEL TANK
AUTO FILLER AND CAP
NOTE!
DIMENSIONS WILL NEED TO BE CHECKED ON THE AIRCRAFT
FLOAT TYPEFUEL GAUGE
CORK FLOAT SEAL WITH POLYESTER OR EPOXY
5mm FLANGE ALL ROUND .040" COMM ALUM.
300
200
400
POSITION FILLER NECK & DRAIN TO SUIT
FUEL MUST DRAIN TO SEDIMENT BOWL WHEN AIRCRAFT IS ON THE GROUND
HAVE TANK "WELDED" BY A COMPETANT ALUM WELDER.

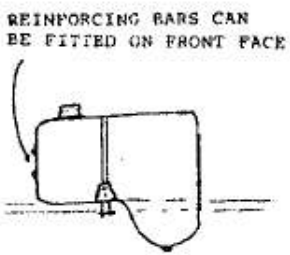
CONSTRUCT FROM "EPOXY" OR "VYNAL ESTER"

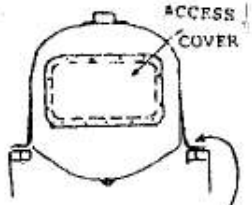
FUEL TANK.

G.R.P.TANK.
MAKE A SUITABLE MALE MOULD FROM A FOAM THAT DOES NOT MELT WHEN PAINTED ALLOW IT TO BE ENOUGH SMALLER THAN REQUIRED TO ALLOW FOR GLASS THICKNSS AND MOUNTING BRACKETS.MAKE FROM FOAM SHEET OR BLOCKS TO MAKE HOLLOW WITH THE REAR WALL OBOUT 2" THICK GLUE ON A LUMBER BLOCK USING GLUE ON THE SCREWS.THEN MOUNT A SQUARE TUBE SAY ½ OR ¾ MAKE A STAND WITH A HEAVY BASE OR SCREW TO THE FLOOR ON TOP OF WHICH IS MOUNTED 2 SHORT TUBES ONE HORISONTEL AND ONE VERTICAL SO THE MOULD TUBE CAN FIT INSIDE ,THIS ALLOWS FOR THE MOULD TO BE TURNED ANY DIRECTION.

NOW SHAPE THE MOULD TO SUIT,WHEN SHAPED FILLANY HOLES AND DEFECTS, SAND AND PAINT AS IF IT WAS THE FINISHED PRODUCT.POLISH IT WITH MANY COATS OF MOULD WAX,THEN COAT WITH MOULD RELEASE.

YOU CAN NOW LAY UP YOUR TANK BUT NOT OVER THE MOUNT BLOCK. BE SURE NOT TO DAMAGE THE MOULD RELEASE WITH YOUR FIRST COAT.WHEN EACH COAT IS DRY SAND ANY SPIKES AND LUMPS TO KEEP A GOOD FINISH. AT THE SAME TIME MAKE A FLAT PANEL TO SUIT THE BACK PANEL,THIS WILL BE GLUED AND RIVETED ON LATER. NEAR THE END BOND IN THE FILLER NECK AND OUTLET,WITH EMERY ROB IN RESIN ON THE METAL TO ENSURE A GOOD BOND ALSO BOND IN A MOUNING STRAP. NOW WHEN ALL IS FINISHED REMOVE THE MOUNT BLOCK AND BREAK UP THE MOULD THROUGH THE REAR OPENING AND CLEAN THE INTERIOR,WHEN SATISFIED BOND ON THE REAR PANEL.
YOU MUST STUDY THE RESIN SUPPLIERS INSTRUCTIONS.

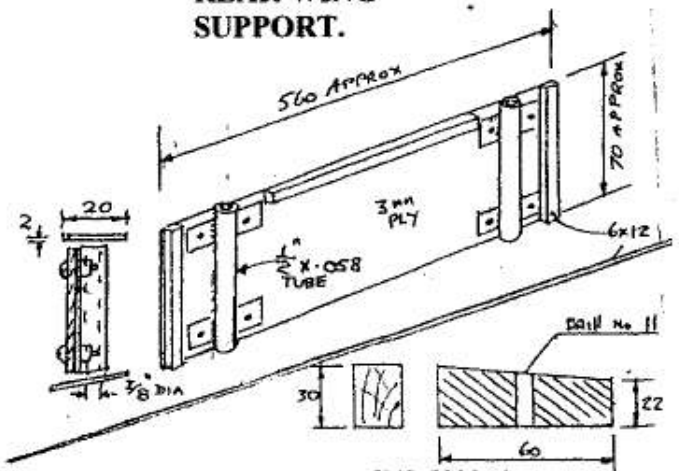




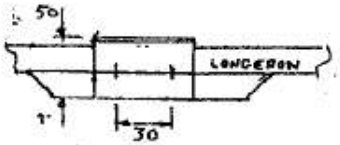
MOUNT BRACKETS AND STRAP

FILLER NECK

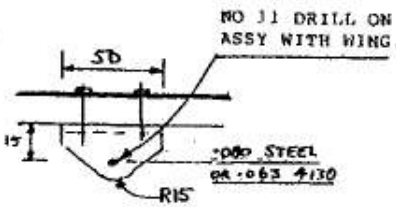
REAR WING SUPPORT.

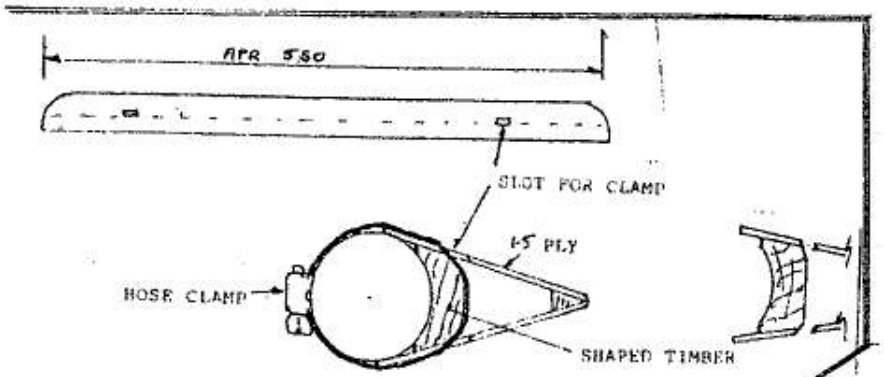


SPAR BLOCK REAR WING

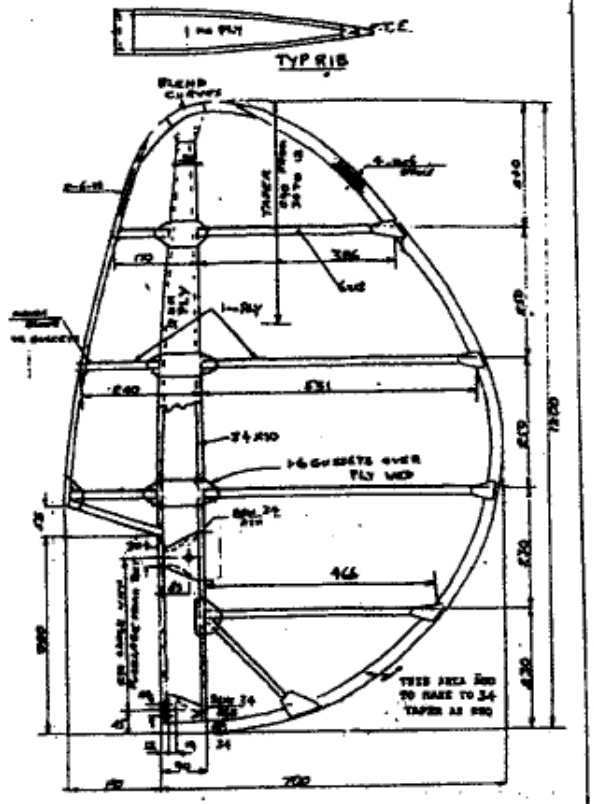


REAR SPAR FITTING





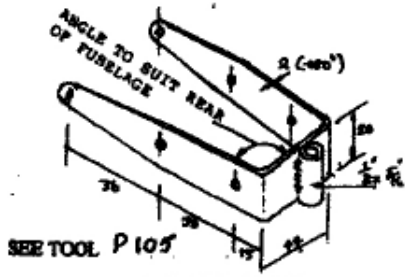
SHOCK STRUT FAIRING.



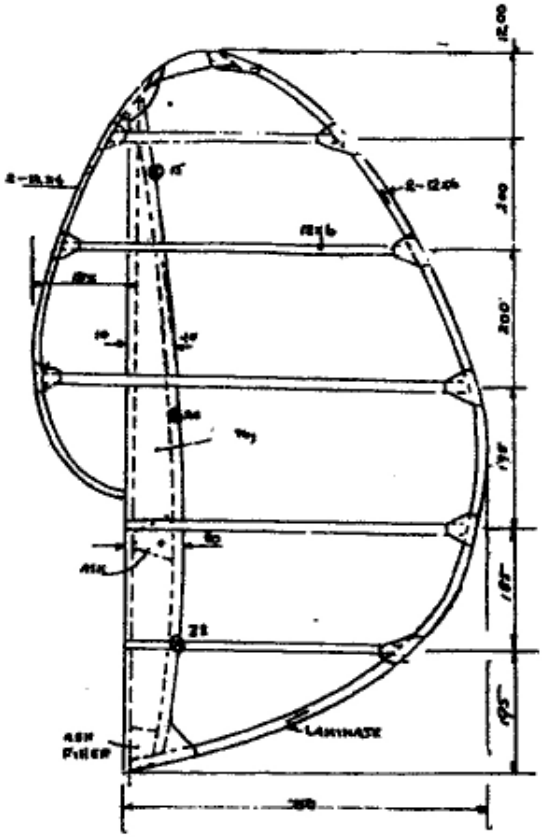
STYLE 2

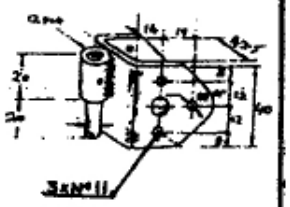
IT WOULD PAY TO LAY OUT THE RUDDER FULL SIZE AND CHECK DIM. THIS WILL HELP TO PLAN CONSTRUCTION

Because of the angle of this fitting
You can make tapered washers braze
Or bond to the fitting.



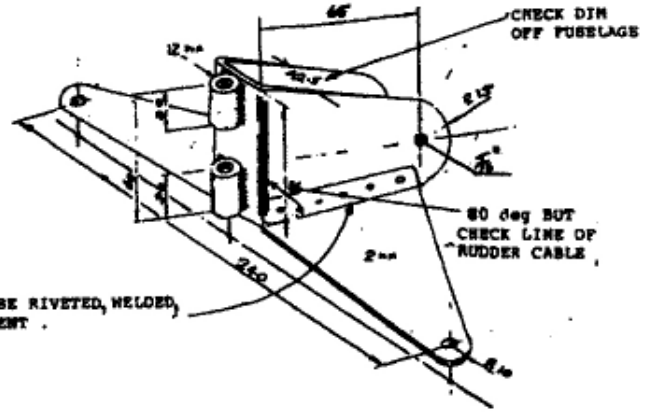
FUSELAGE ATTACHMENT BRACKETS 2 REQ



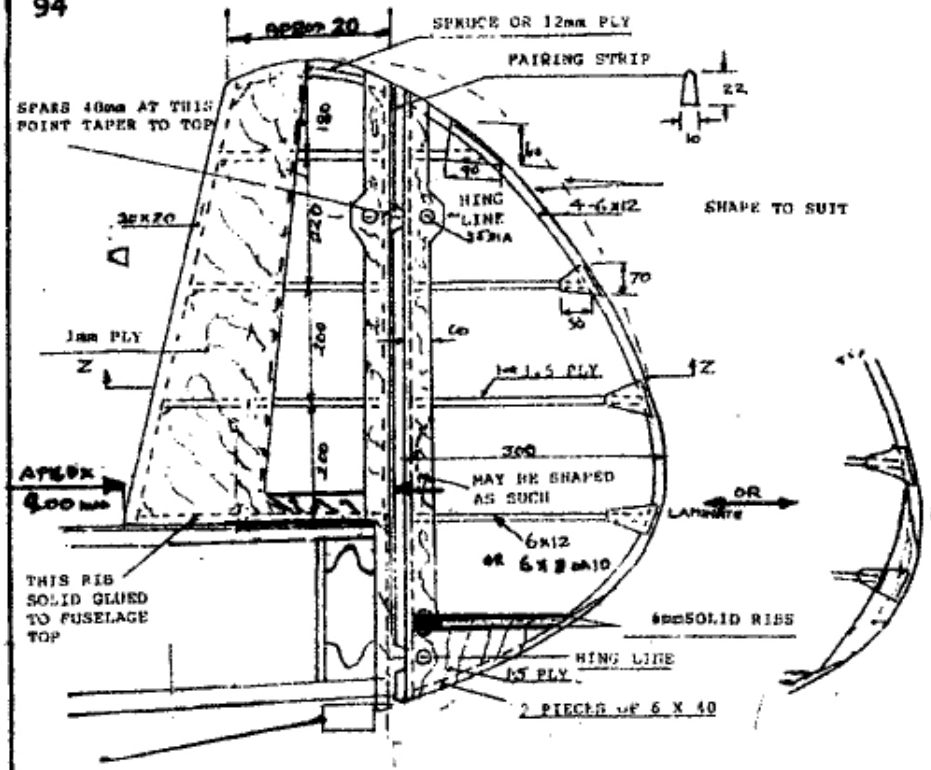


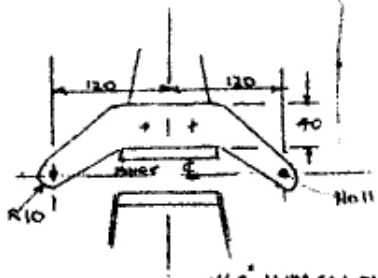
THESE HOLES TO MATCH HOLES IN LOWER RUDDER USE FITTING TO DRILL RUDDER

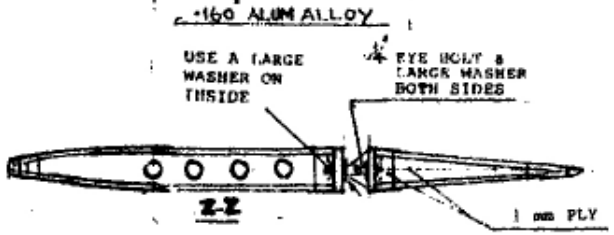
STYLE 1



RUDDER'S **SEE DRILL JIG.**





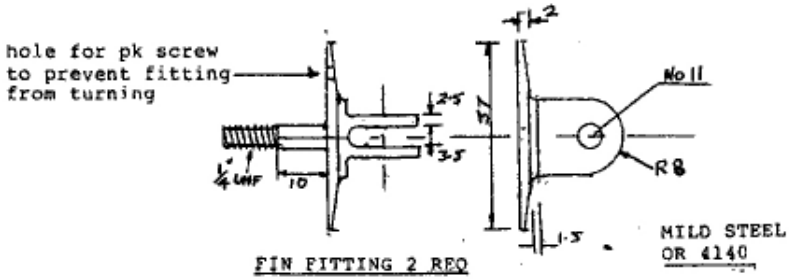


NOTE.
SPARS AT HINGELINE 10mm. CAN BE FACED WITH 1.5mm PLY, CROSS GRAIN TO REDUCE SPLITTING. CAN BE REDUCED TO 9.5Mm.

FIN AND RUDDER.

FIN AND RUDDER REVISION.

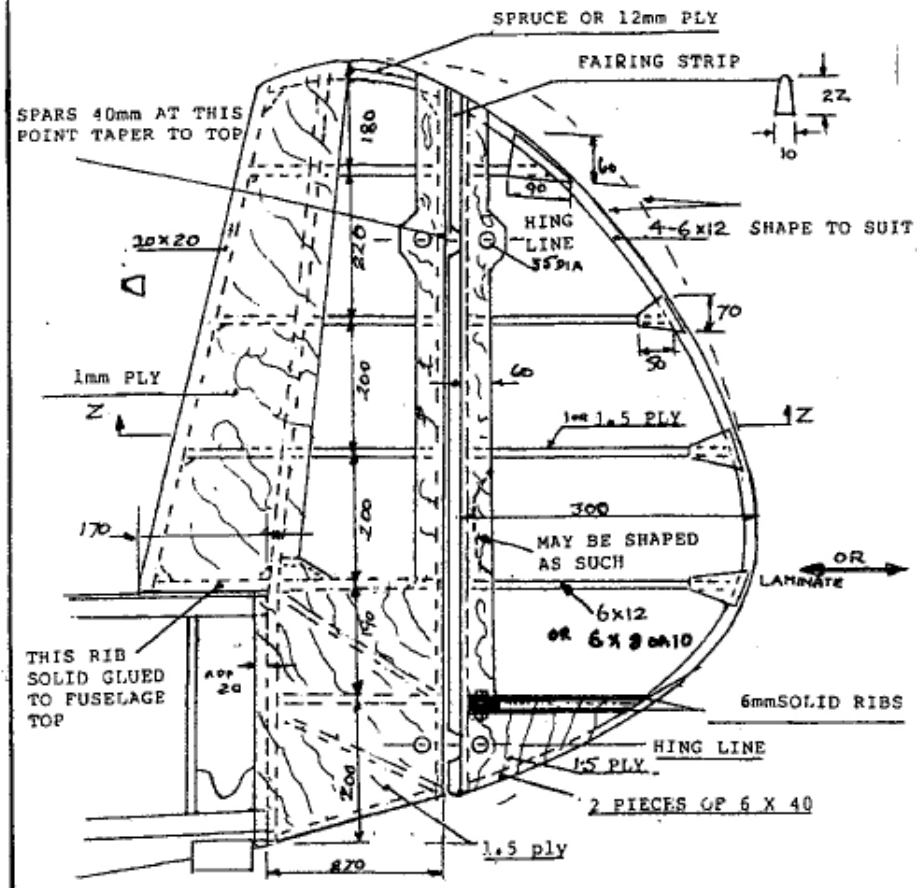
NOTE. Drawing 20A is a retrofit for the standard fuselage. If you start out building the fin and rudder style you will use the longer fuselage dimensions, and construct similar to 20A. This drawing shows the differences.
The solid rib you shape to nice lines and glue to the 3mm ply fuselage deck. A short cross member unde this ply at the contact point of the leading edge. the fin spar is 10mm ply faced towards the rudder with the grain horizontal. At this point clamp the rudder in place with spacer blocks or fit the hinges at this time. The next rib is made to fit at the point just below where the spar starts its taper. Shape similar to the lower one. Now using a straight edge and template material shape the rib in between and the one above. Remember to keep in line with the rudder ribs. The position of the lower hinge will depend on the U shaped blocks in the fuselage. Glue pieces of 6x6mm timber at the rear of the fin ply to stop buckling.
When deciding on the lower fin length check the distance the rear wing will come to so as not to interfear with the "Cossandey Flap".



FIN FITTING 2 REQ

ONE STYLE OF HING
OTHERS MAY BE AVAILABLE

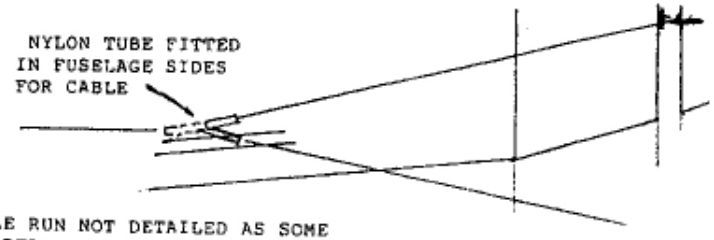
You can use 2 eye bolts on the fin and one on the Rudder.



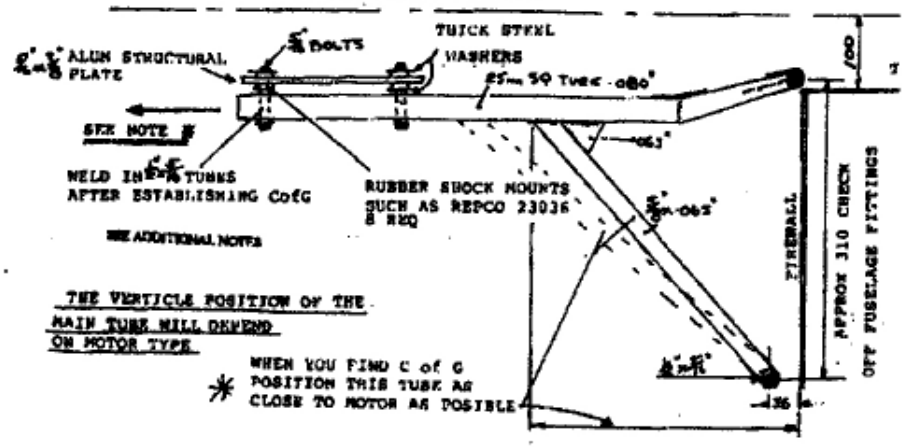
RETRO FIT RUDDER.

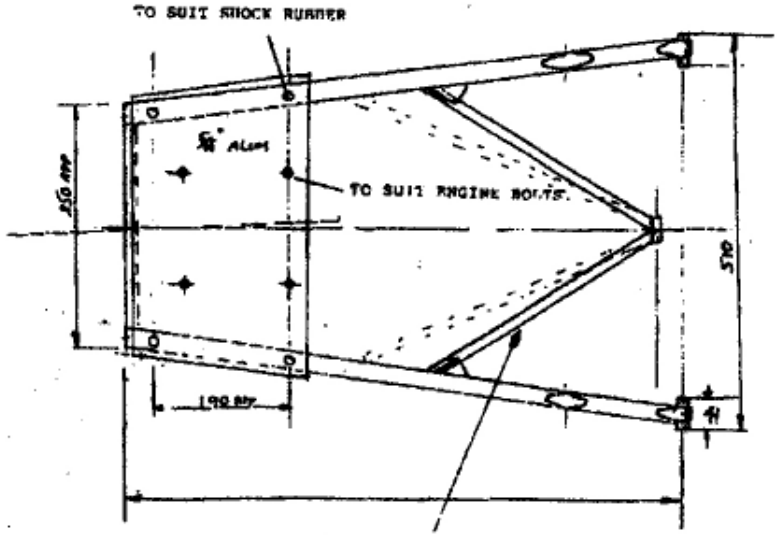
USE 4" COPPER TUBE THROUGH FUSELAGE FRAME 3

SPAR APP 42 MAKE THE SAME AS FINISHED SIZE OF FUSELAGE REAR ASPLY ON FIN TO OVERLAP APP 20 mm



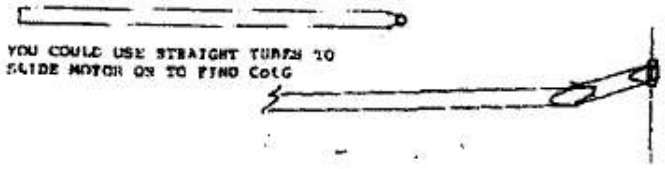
CABLE RUN NOT DETAILED AS SOME BUILDERS MAY USE PEDALS FOR TAIL WHEEL STEERING


MOTOR MOUNTED SO AXIS OF PROP IS 100mm ABOVE LONGERON
THICK STEEL WASHERS
BOLTS
ALUM STRUCTURAL PLATE
SEE NOTE
WELD IN TURNS AFTER ESTABLISHING CofG
RUBBER SHOCK MOUNTS SUCH AS REPCO 23036 8 REQ
SEE ADDITIONAL NOTES
THE VERTICLE POSITION OF THE MAIN TUBE WILL DEPEND ON MOTOR TYPE
WHEN YOU FIND C of G POSITION THIS TUBE AS CLOSE TO MOTOR AS POSIBLE
FIREWALL
APPROX 310 CHECK OFF FUSELAGE FITTINGS



A tempory tube with a flatend end or plate welded on at the Correct angle to clamp to the main motor tube while you establish The CofG will help (or even a piece of hardwood cut at the right angle).

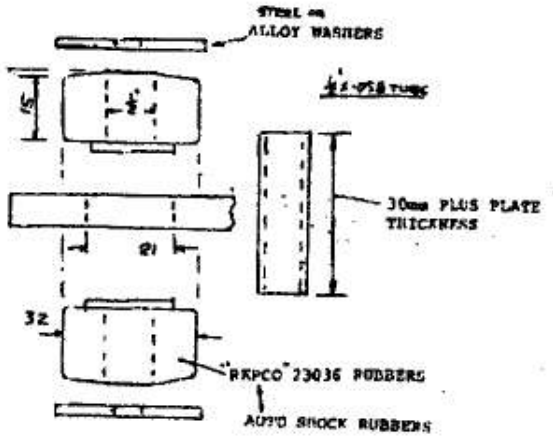
MOTOR MOUNT.



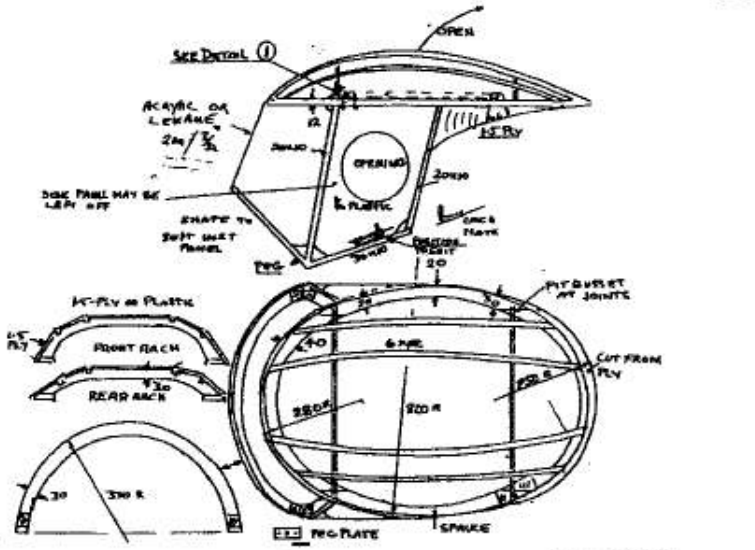
VIEW A IT MAY BE NECESSARY TO CRANK SOME INWARDS DEPENDING ON MOTOR

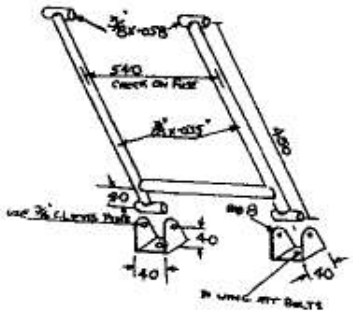
* NOTE THE ENGINE MOUNT SHOULD BE ONE OF THE LAST ITEMS TO BE MADE SO THE MAIN TUBES CAN BE LEFT OVER LENGTH. THE MOTOR CAN THEN BE SLID BACK &FWD TO OBTAIN THE CORRECT C of G

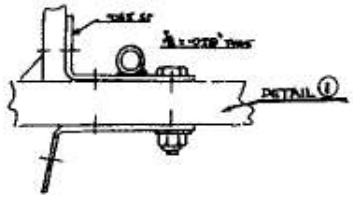
THIS WILL THEN ESTABLISH THE POSITION OF THE RUBBER MOUNT TUBES

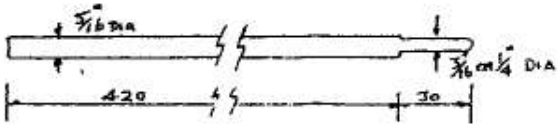


MOTOR MOUNT CONT,.



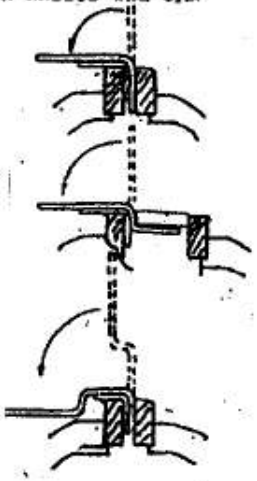


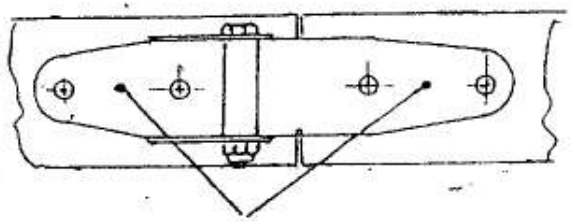




ALIGNMENT ROD FOR HINGES

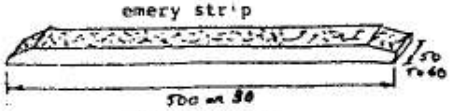
FIT DEEPER JAWS TO YOUR VICE FOR BENDING THE CATCH PLATE ⑤ BEND A PIECE OF MILD STEEL TO FORM A RAD, OR RADIUS THE JAW



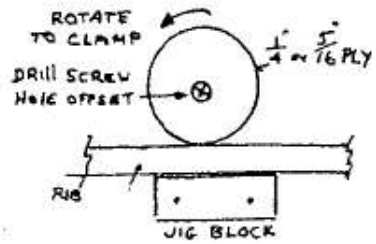


DRILL A SMALL HOLE FOR A P.K. SCREW TO HOLD FITTING IN PLACE WHILE DRILLING THE SPAR BOLT HOLES.
SAME FOR ALL HING AND CATCH FITTINGS

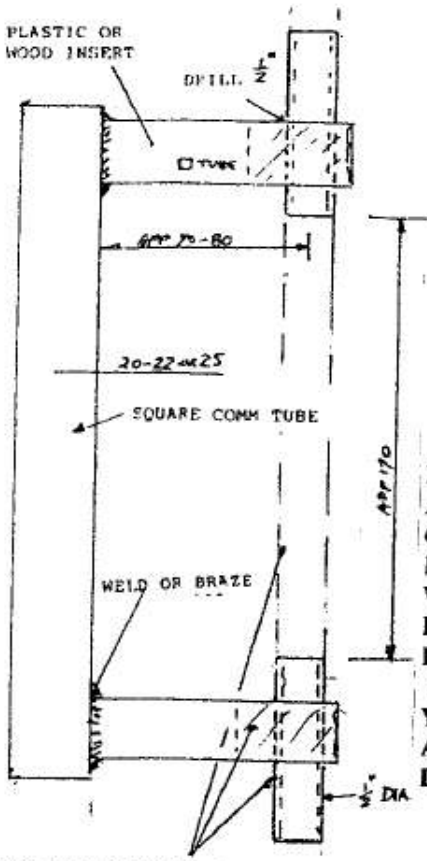
FOR RIGGING THE WINGS MAKE A FULL SIZE RIB TEMPLATE WITH THE RIB DATUM MARKED ON IT. ALLOW A FEW HOLES TO MARK THE DATUM ON THE END RIB OF THE WING CENTRE SECTION. THEN USE PIECE OF WOOD CLAMPED ON THE RIB AND USE A ADJUSTABLE LEVELTO SET THE WINGS CORRECTLY WITH THE CONTROL COLUMN IN A NEUTRAL POSITION, PUSH ROD LENGTH ETC CAN BE DETERMIND.



SANDING BOARD



RIB CAP CLAMP



INSERT LENGTH OFTUBE AND POT WITH EPOXY RESIN AFTER DRY CUT OUT EXCESS TUBE

THIS IS THE SPAR DRILL JIG BUT OTHERS CAN BE MADE FOR THE PLAIN RUDDER HINGE ETC.

DO NOT WELD THE 1/2" TUBE AS IT CAN DISTORT WHEN THE CENTER SECTION IS REMOVED FILL TUBES TO NEAR THE HOLE WITH A WOODEN OR PLASTIC PLUG. SCORE THE ½" TUBE AT HOLE POSITION AND BOND IN WITH EPOXY RESIN.
YOU CAN USE OTHER SIZE TUBES AS YOU WISH WITH THE CORRECT DRILL SIZE CENTER'S.

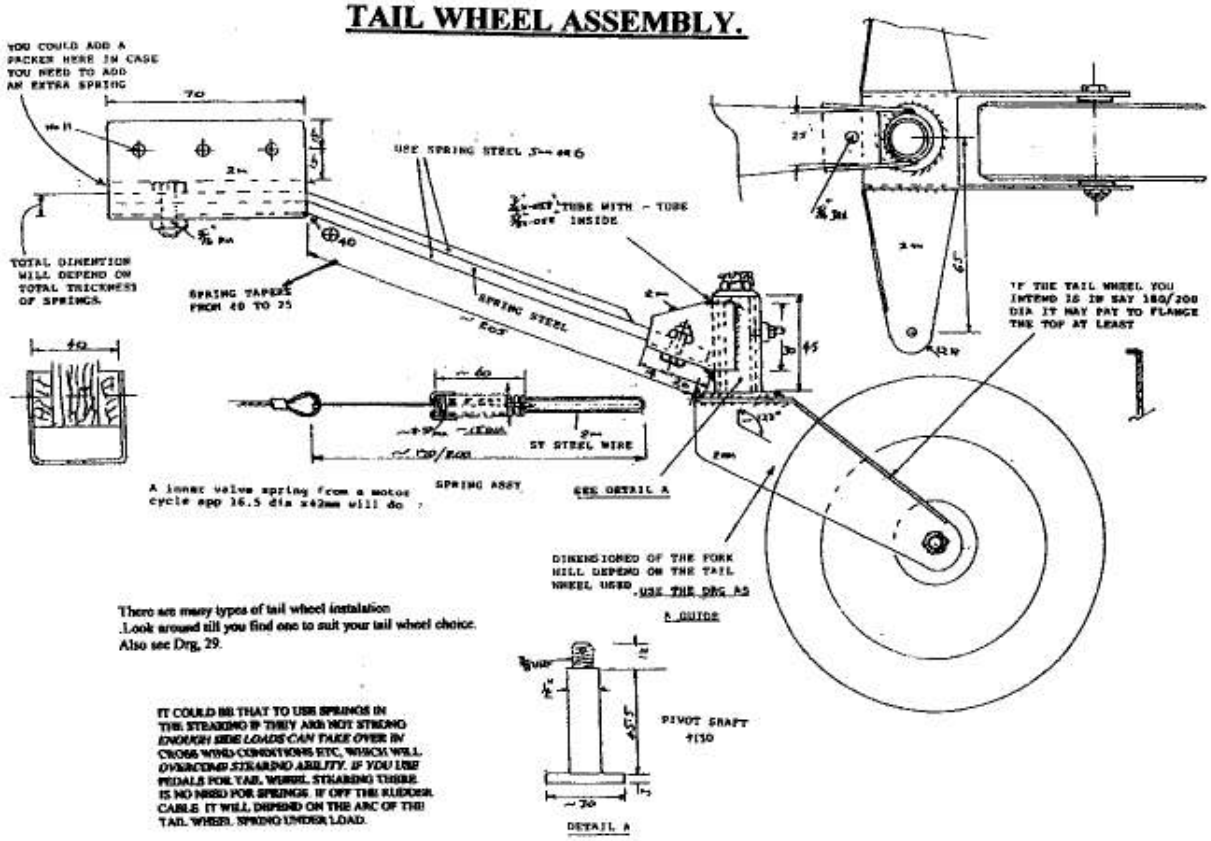
THIS JIG CAN BE HAND HELD IF USED CORRECTLY. 2PEOPLE MAKE IT SIMPLER. STUDY WHAT YOU ARE GOING TO DO FIRST.

MAKE A SERIES OF INSERTS TO SUIT. INTERIOR OF ½ TUBE HAVING 3/16 5/16 AND 7/16 BORES SPIGGOT TOINDEX IN HING FITTINGS.

LOCATE FITTINGS ON SPAR USE P.K TO HOLD IN PLACE. INSERT DRILL TUBE IN LOWER FITTING AND USING A LONG SERIES DRILL & DRILL A PILOT HOLE IN TOP OF SPAR USING TUBE WITH SPIGGOT THEN CHANGE DRILL TUBE AND DRILL FINISHED SIZE.
YOU CAN THEN INSERT A ROD TO LOCATE THEN DO THE SAME IN LOWNER FITTING.

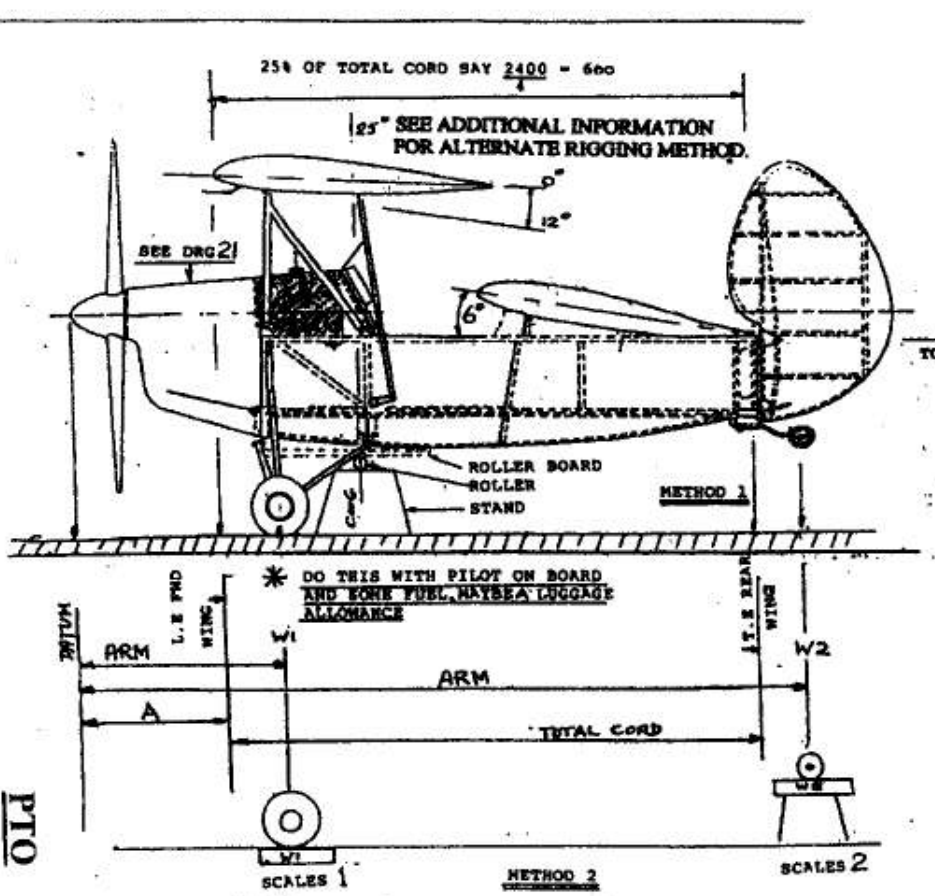
SPAR DRILL JIG. PLUS OTHER TOOLS.

TAIL WHEEL ASSEMBLY.


YOU COULD ADD A PACKER HERE IN CASE YOU NEED TO ADD AN EXTRA SPRING
TOTAL DIMENTION WILL DEPEND ON TOTAL THICKNESS OF SPRINGS.
USE SPRING STEEL
TUBE WITH - TUBE OFF INSIDE
SPRING TAPERS FROM 40 TO 25
SPRING STEEL
ST STEEL WIRE
SPRING ASSY
SEE DETAIL A
IF THE TAIL WHEEL YOU INTEND IS IN SAY 180/200 DIA IT MAY PAY TO FLANGE THE TOP AT LEAST
DIMENSIONED OF THE FORK WILL DEPEND ON THE TAIL WHEEL USED. USE THE DRG AS A GUIDE
A inner valve spring from a motor cycle app 16.5 dia x42mm will do .

There are many types of tail wheel installation .Look around till you find one to suit your tail wheel choice. Also see Drg. 29.

IT COULD BE THAT TO USE SPRINGS IN THE STEERING IF THEY ARE NOT STRONG ENOUGH SIDE LOADS CAN TAKE OVER IN CROSS WIND CONDITIONS ETC, WHICH WILL OVERCOME STEERING ABILITY. IF YOU USE PEDALS FOR TAIL WHEEL STEERING THERE IS NO NEED FOR SPRINGS. IF OFF THE RUDDER CABLE IT WILL DEPEND ON THE ARC OF THE TAIL WHEEL SPRING UNDER LOAD.



EXAMPLE

	KG W1/2	x ARM =	MOMENT
1 STB	122	x 1060 =	129320
1 PORT	122	x 1060 =	129320
2 TW	38	x 3525 =	133950
TOT W	282	+	392590

+ 282 = 1392.16 MOMENTS A
733
599.16 C of G

SAY TOTAL CORD 2400 ÷ 4 = 600 = 25%

REMEMBER TO ADD ANY GAP TO THE TOTAL CORD. SAY A GAP OF 150mm GIVES 2550÷4 = 637.5

C of G RANGE 23 TO 27½ OF TOTAL CORD

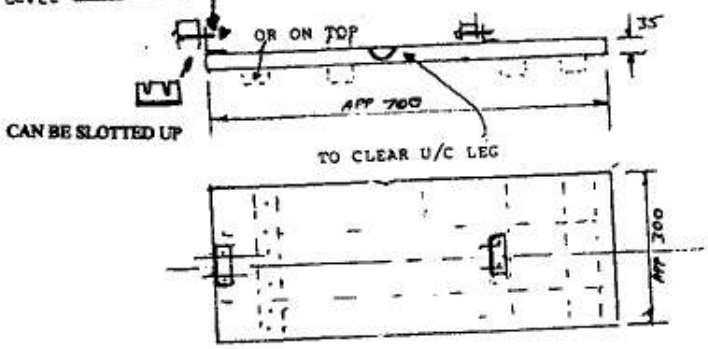
SCALE	KG	x ARM =	MOMENT
1			
2			
T/W			
PILOT			
FUEL			
BAG.			
TOT W =			

PTO

WEIGHT AND BALANCE.

CHECK THE HEIGHT OF THESE BRACKETS TO MAKE THIS BOARD LEVEL WHEN FUSELAGE TOP LONGERON IS LEVEL

REMOVE NUT FROM U/C FITTINGS AND SLIP ON ROLLER BOARD REPLACE NUT



BOARD COULD BE MADE FROM NARROWER PIECES AND JOINED WITH CLEATS AVOID COFG POSITION

IT PAYS ALSO TO DO AN EMPTY C of G WITH EITHER METHOD THIS ALLOWS THEN TO CALCULATE WITH OTHER PILOTS AND FUEL QUANTITIES ETC
YOU WILL NEED TO TAKE A MESUREMENT FROM THE DATUM TO THE CENTRE OF THE FUEL TANK ,BAGGAGE COMP,AND THE PILOT

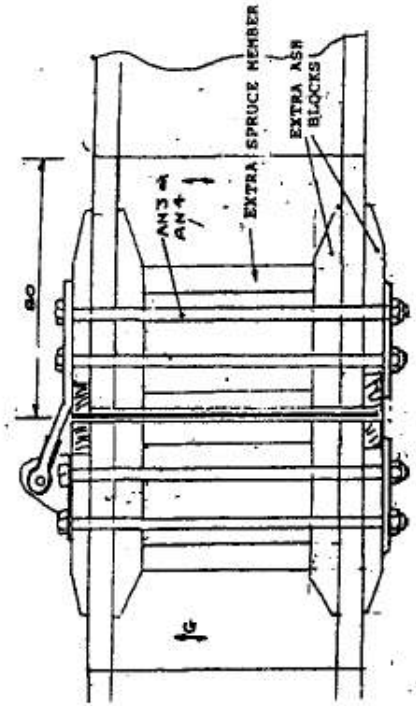
METHOD 1
BECAUSE THE A/C WILL WANT TO TIP FOR AND AFT YOU WILL NEED HELP TO STEADY, BUT NOT TAKE ANY WEIGHT.
REMEMBER TO KEEP THE TOP LONGERON LEVEL IN BOTH METHODS

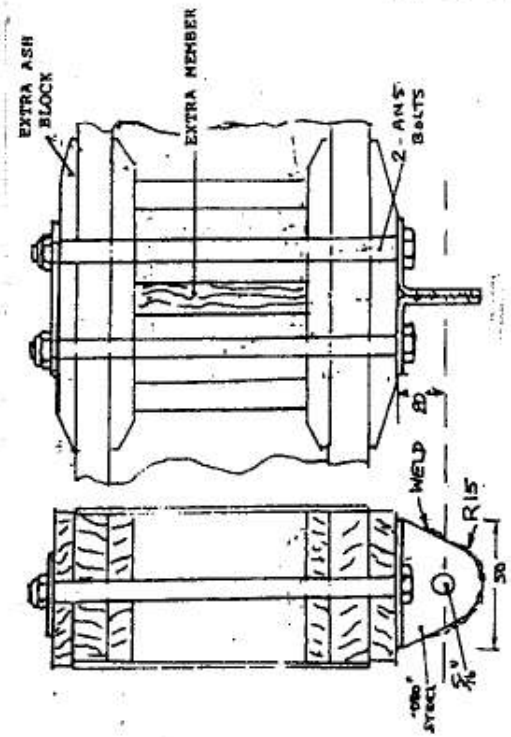
METHOD 2
WHEN YOU HAVE THE A/C LEVEL THEN DROP PLUM BOB AT DATUM, L.E. OF FWD WING,AT BOTH SIDES CLEAR OF THE FUSELAGE, THE CENTRE OF THE WHEELS,T. E OF THE REAR WING AND CENTRE OF THE TAIL WHEEL.
IT HELPS TO STICK MASKING TAPE TO THE FLOOR AT THESE POINTS. JOIN THE L.E.WHEEL, T.E. POINTS,YOU CAN THEN TAKE MESUREMENTS DOWN THE CENTRE FROM THE DATUM.

NOTE! The CofG can be altered bymoving the wing back and ferth.(use a temp adjustable rear cabane strut.) The wing gap may vary from 0 to 500mm.With a heavy engine the wing would move fwd.If the wing becomes lower than 600mm above the top longeron the front strut would need to be lengthend

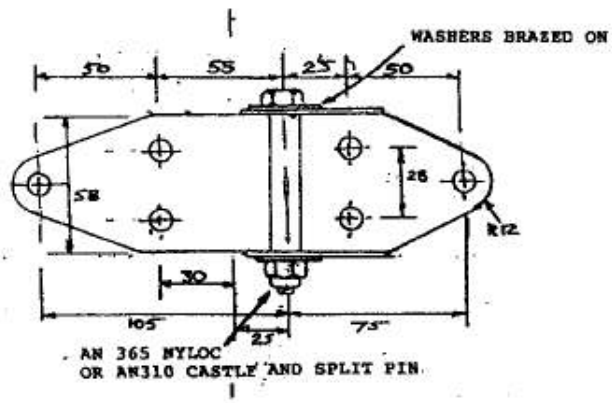
PTO

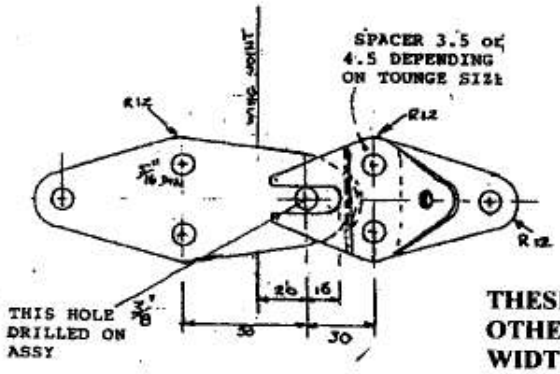
ALTERNATE HINGE FITTING

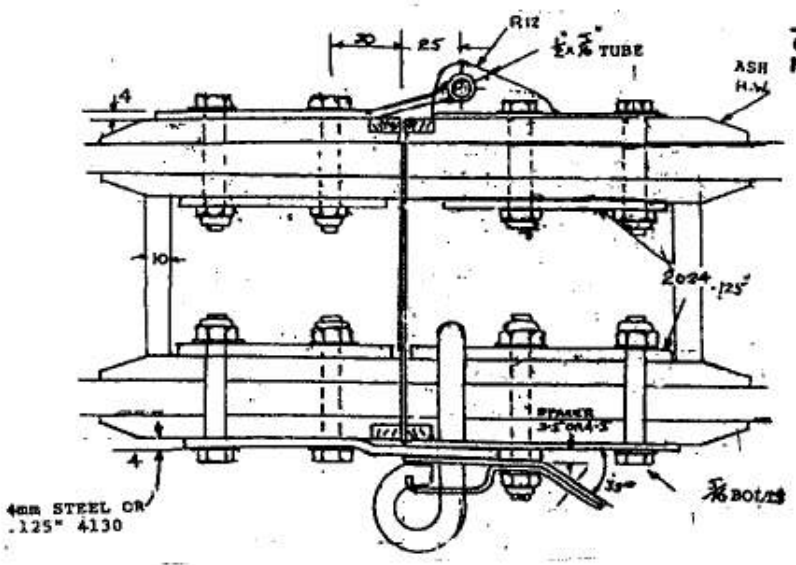




FRONT WING PIVOT ATTACHMENT.





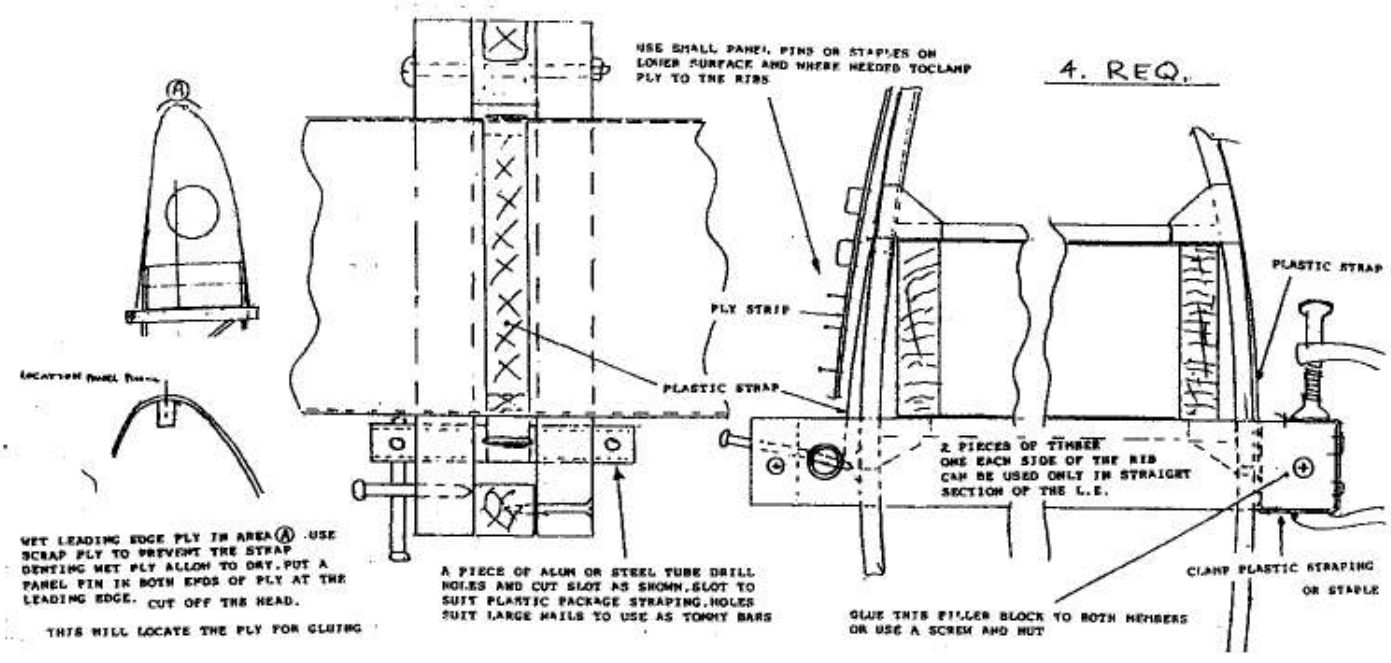


THESE FITTINGS ARE THE SAME AS OTHER DRG'S EXCEPT THAT THE WIDTH IS CHANGED TO ALLOW FOR THE EXTRA BOLT.

POSSIBLE ALT WING HINGE
NOT YET TESTED
SC 38A 28.27
P 111

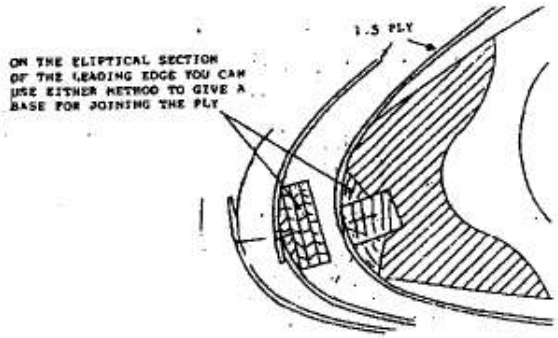
NOTE! THIS IS A POSSIBLE TYPE OF HINGE SET UP BUT NOT YET TRIED.

REAR SPAR WOULD ALSO HAVE A SIMILAR CENTRAL HING.


A
USE SMALL PANEL PINS OR STAPLES ON LOWER SURFACE AND WHERE NEEDED TOCLAMP PLY TO THE RIBS
4. REQ.
PLY STRIP
PLASTIC STRAP
PLASTIC STRAP
2 PIECES OF TIMBER ONE EACH SIDE OF THE RIB CAN BE USED ONLY IN STRAIGHT SECTION OF THE L.E.
WET LEADING EDGE PLY IN AREA (A) .USE SCRAP PLY TO PREVENT THE STRAP DENTING WET PLY ALLOW TO DRY. PUT A PANEL PIN IN BOTH ENDS OF PLY AT THE LEADING EDGE. CUT OFF THE HEAD.
THIS WILL LOCATE THE PLY FOR GLUING
A PIECE OF ALUM OR STEEL TUBE DRILL HOLES AND CUT SLOT AS SHOWN. SLOT TO SUIT PLASTIC PACKAGE STRAPING. HOLES SUIT LARGE NAILS TO USE AS TOMMY BARS
GLUE THIS FILLER BLOCK TO BOTH MEMBERS OR USE A SCREW AND NUT
CLAMP PLASTIC STRAPING OR STAPLE

PTO.

D. NOSE SKINNING.



* DO NOT USE THE BROAD TYP STAPLES
LOOK FOR THE MORE ROUND TYPE .
Say 10 x 8

SUCH AS 'SEMCO' BO-4=6mm BO6=10mm

USE SCRAP PLY OR SIMILAR UNDER STAPLES OR PANEL PINS THIS ALLOWS YOU TO REMOVE THEM WITHOUT DAMAGE TO THE PLY SKIN.

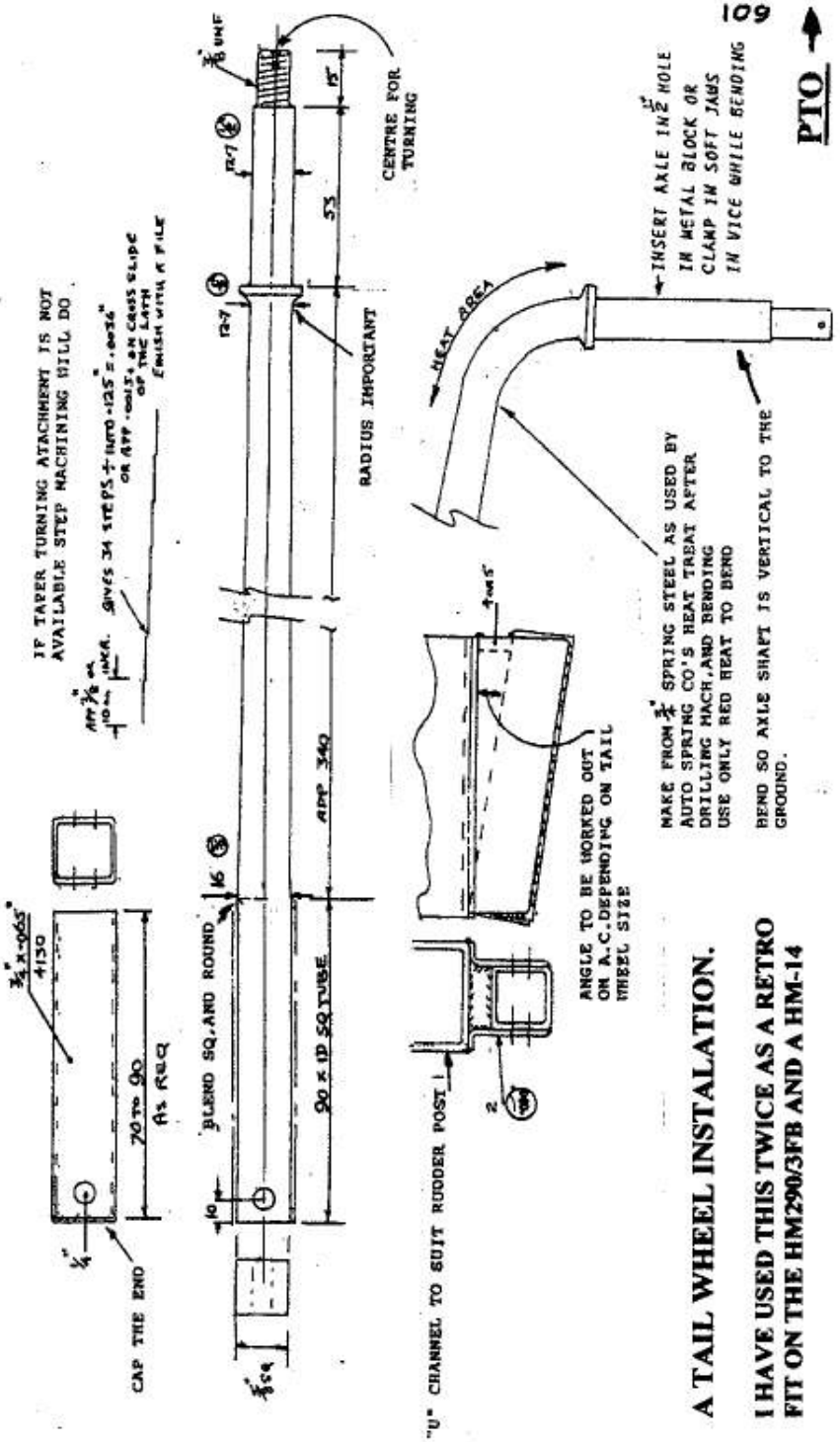
ALONG THE LEADING EDGE AT THE RIBS WHERE PLY IS TO BE SPLICED ADD EXTRA THICKNESS TO THE RIBS TO SUPPORT THE SPLICE.

Virtualy any means you can find to hold the leading edge ply firmly
Till the glue dry's will do but remember where there flat surfaces tack strips or clamps may be required.

TRIAL FIT YOUR PLY, SOAK THE LEADING EDGE AREA FIT AND ALLOW TO DRY, INSTALL LOCATING PINS, REACH IN AND MARK RIB, AND OTHER MEMBERS. ALSO MARK THE OUTSIDE OF THE PLY TOSHOW WHERE TO PUT STRAPS OR TACK STRIPS. PAINT ALL AREAS NOT TO BE GLUED. A 2 PART EPOXY PAINT IS RECOMENDED.

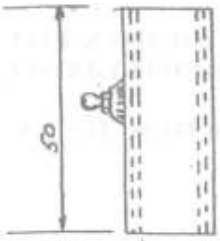
PLY SPLICE L.EDGE.

PTO

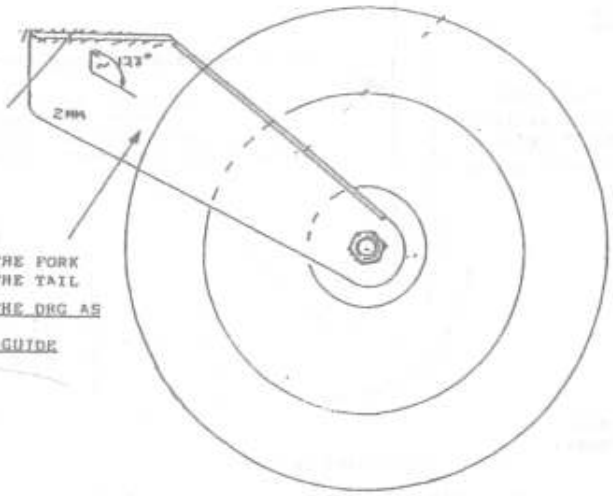

IF TAPER TURNING ATTACHMENT IS NOT AVAILABLE STEP MACHINING WILL DO
GIVES 34 STEPS @ .0036" OR APP .005" ON CROSS SLIDE
CENTRE FOR TURNING
RADIUS IMPORTANT
BLEND SQ. AND ROUND
90 x 10 SQ TUBE
APP 340
53
CAP THE END
AS REQ
70 TO 90
4130
"U" CHANNEL TO SUIT RUDDER POST
HEAT AREA
INSERT AXLE IN 12" HOLE IN METAL BLOCK OR CLAMP IN SOFT JAWS IN VICE WHILE BENDING
MAKE FROM 3/8" SPRING STEEL AS USED BY AUTO SPRING CO'S HEAT TREAT AFTER DRILLING MACH. AND BENDING USE ONLY RED HEAT TO BEND
BEND SO AXLE SHAFT IS VERTICAL TO THE GROUND.
ANGLE TO BE WORKED OUT ON A.C. DEPENDING ON TAIL WHEEL SIZE

A TAIL WHEEL INSTALATION.

I HAVE USED THIS TWICE AS A RETRO FIT ON THE HM290/3FB AND A HM-14



USE A [illegible] TUBE INSIDE A [illegible]
THIS STOPS HELD PENERTRATION
MAKING IT LESS OF A PROBLEM
TO CLEAN UP THE BORE AFTER WELDING



DIMENSIONED OF THE FORK
WILL DEPEND ON THE TAIL
WHEEL USED. USE THE DRG AS
A GUIDE

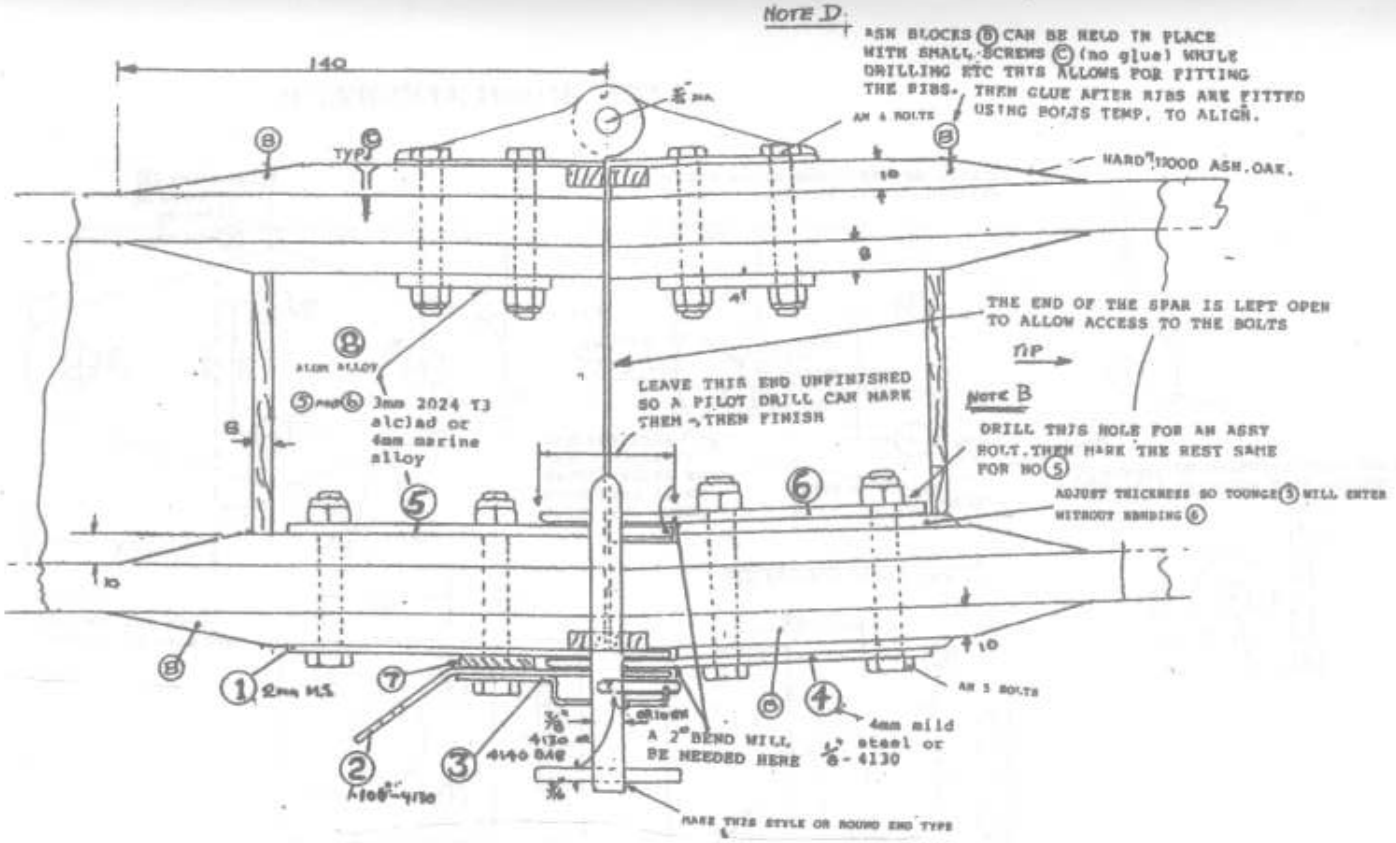
FORK AND STEARING ARM MADE
TO SUIT TAIL WHEEL.

SEE DRG 25

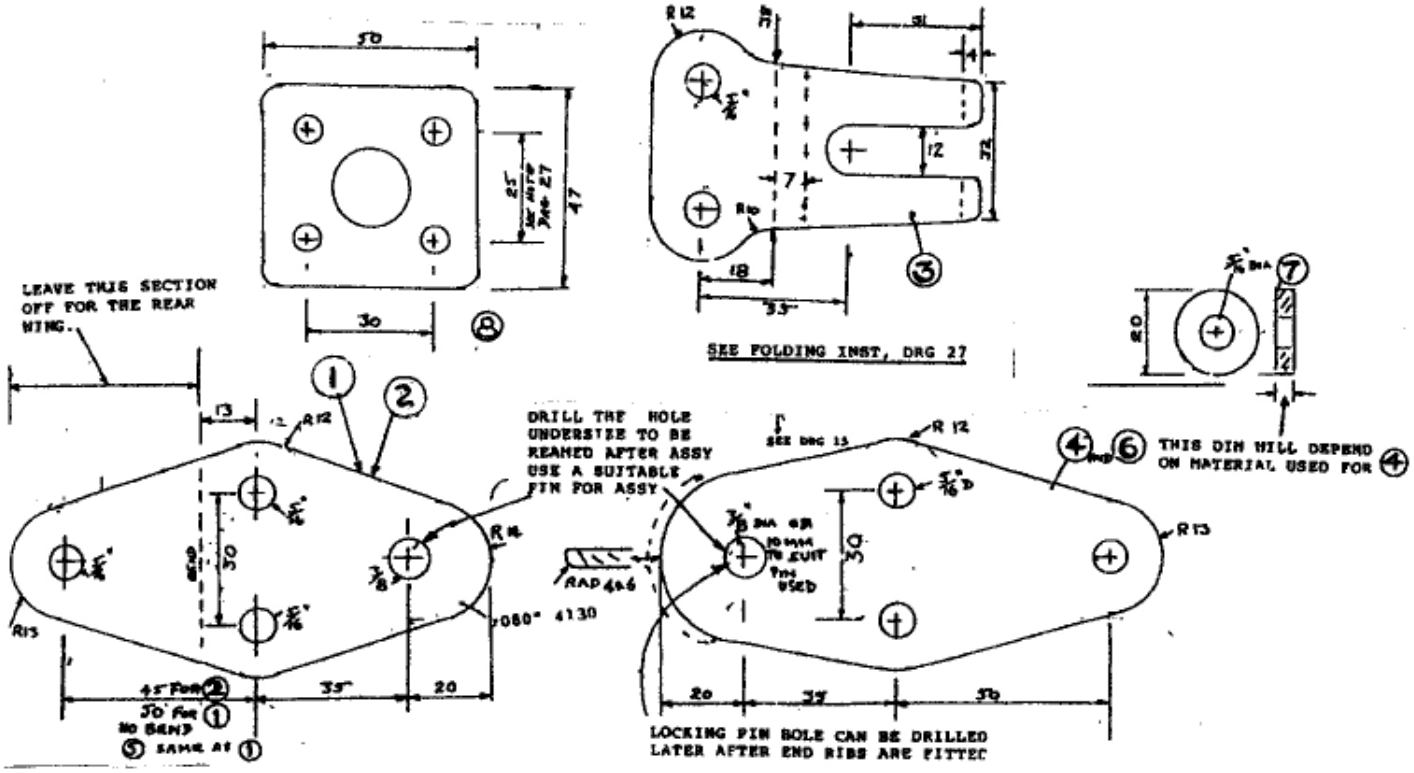
IF THE TAIL WHEEL YOU
INTEND IS IN SAY 180/200
DIA IT MAY PAY TO FLANGE
THE TOP AT LEAST

IT COULD BE THAT TO USE SPRINGS IN THE STEARING IF THEY ARE NOT STRONG *ENOUGH SIDE LOADS CAN TAKE OVER IN* CROSS WIND CONDITIONS ETC, WHICH WILL *OVERCOME STEARING ABILITY. IF YOU USE* PEDALS FOR TAIL WHEEL STEARING THERE IS NO NEED FOR SPRINGS. IF OFF THE RUDDER CABLE IT WILL DEPEND ON THE ARC OF THE TAIL WHEEL SPRING UNDER LOAD.

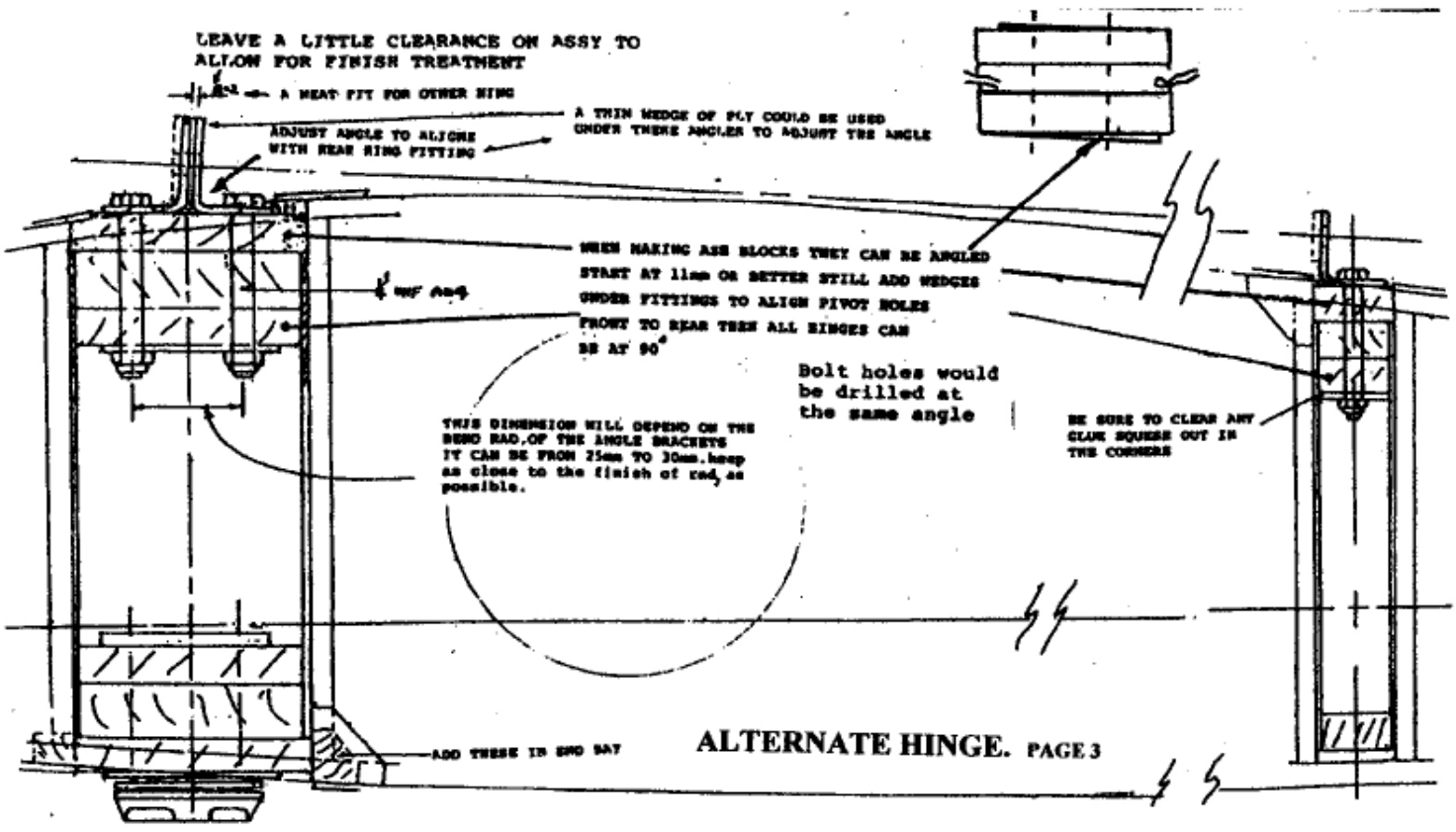
TAIL WHEEL CONT,.


NOTE D
ASH BLOCKS (B) CAN BE HELD IN PLACE WITH SMALL SCREWS (C) (no glue) WHILE DRILLING ETC THIS ALLOWS FOR FITTING THE RIBS. THEN GLUE AFTER RIBS ARE FITTED USING BOLTS TEMP. TO ALIGN.
140
AN 4 BOLTS
HARD WOOD ASH. OAK.
THE END OF THE SPAR IS LEFT OPEN TO ALLOW ACCESS TO THE BOLTS
FIN
NOTE B
DRILL THIS HOLE FOR AN ASSY BOLT. THEN MARK THE REST SAME FOR NO (5)
ADJUST THICKNESS SO TOUNGE (3) WILL ENTER WITHOUT BINDING (6)
LEAVE THIS END UNFINISHED SO A PILOT DRILL CAN MARK THEM - THEN FINISH
3mm 2024 T3 alclad or 4mm marine alloy
ALUM ALLOY
AN 3 BOLTS
2mm MS
4mm mild steel or 4130
A 2" BEND WILL BE NEEDED HERE
MAKE THIS STYLE OR ROUND END TYPE

PREFERED ALTERNATE HINGE METHOD. PAGE 1 OF 4.


LEAVE THIS SECTION OFF FOR THE REAR WING.
SEE FOLDING INST, DRG 27
DRILL THE HOLE UNDERSIZE TO BE REAMED AFTER ASSY USE A SUITABLE PIN FOR ASSY
THIS DIM WILL DEPEND ON MATERIAL USED FOR
LOCKING PIN HOLE CAN BE DRILLED LATER AFTER END RIBS ARE FITTED

ALTERNATE HINGE PAGE 2


LEAVE A LITTLE CLEARANCE ON ASSY TO ALLOW FOR FINISH TREATMENT
A NEAT FIT FOR OTHER WING
A THIN WEDGE OF PLY COULD BE USED UNDER THESE ANGLES TO ADJUST THE ANGLE
ADJUST ANGLE TO ALIGNE WITH REAR WING FITTING
WHEN MAKING ASS BLOCKS THEY CAN BE ANGLED START AT 11mm OR BETTER STILL ADD WEDGES UNDER FITTINGS TO ALIGN PIVOT HOLES FRONT TO REAR THEN ALL HINGES CAN BE AT 90°
Bolt holes would be drilled at the same angle
THIS DIMENSION WILL DEPEND ON THE BEND RAD. OF THE ANGLE BRACKETS IT CAN BE FROM 25mm TO 30mm. keep as close to the finish of rod as possible.
BE SURE TO CLEAR ANY GLUE SQUEEZE OUT IN THE CORNERS
ADD THESE IN SAME WAY

ALTERNATE HINGE. PAGE 3

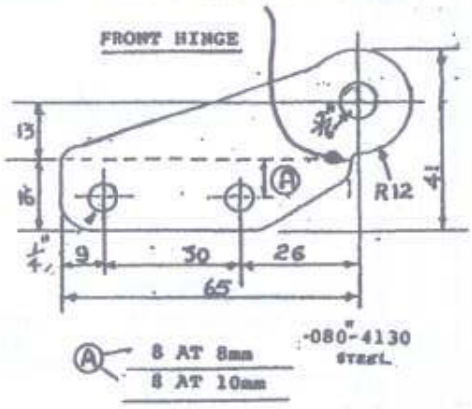
IT IS BETTER TO FOLD THESE HINGES AS A RECTANGLE , THEN SHAPE AND DRILL.

WHEN BENDING METAL IT IS A GOOD IDEA TO RADIUS THE EDGES TO PREVENT CRACKS DEVELOPING.

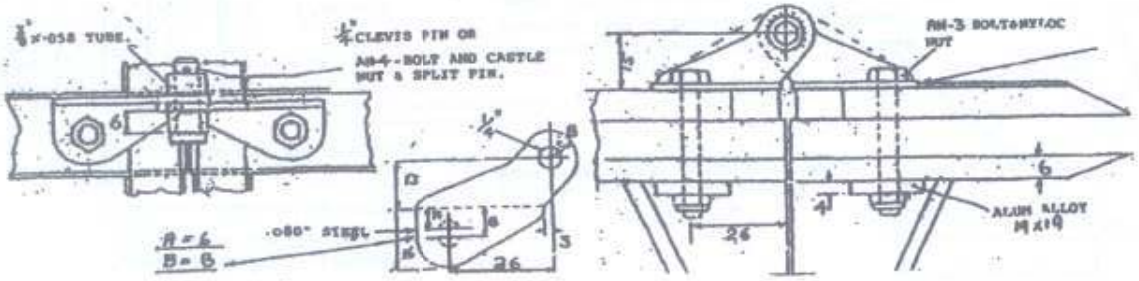
ENLARGED —— ENLARGED.

"DURAGAL" IS STRONGER THAN MILD STEEL.

ASSEMBLE HINGES OFF THE SPAR & CHECK & CHECK FOR FITTING IN THIS AREA AND FOR FULL SWING OVER.



REAR HING.



ALTERNATE HINGE. PAGE 4

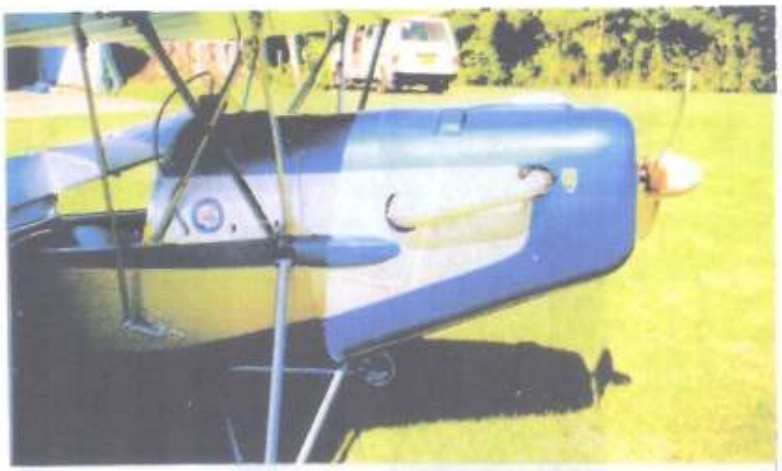
A bit more on the tank. You can see the hold down Straps and mounting brackets. The brackets have holes In them, to allow resin to pass through. The stiffeners can be seen in the front panel. These can be shaped wood or suitable shaped alumin..

The same routine is used for the filler neck and water Drain adapter fitting. The webs are drilled for the resin Passage. To obtain a good bond use wet and dry paper And sand the surface with resin on the paper. This will Prevent the oxidization from returning.

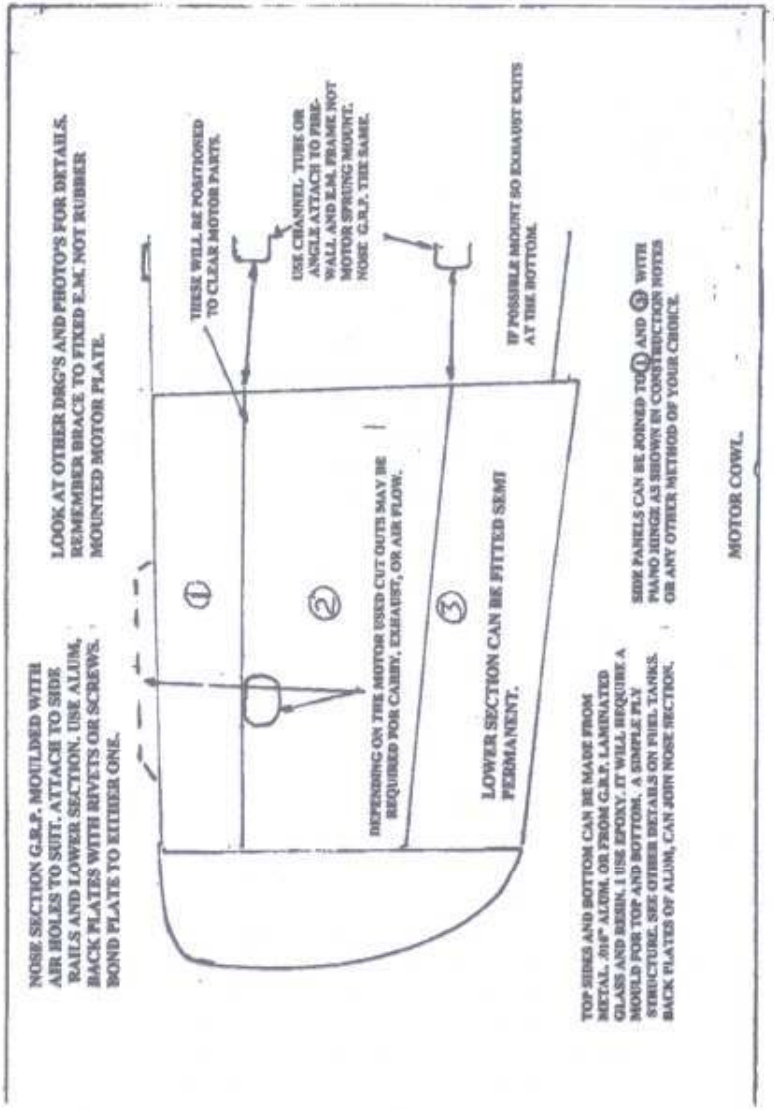
TANK FILLER NECK. P27

COWLE MOULD.

GLASSING THE COWLE.

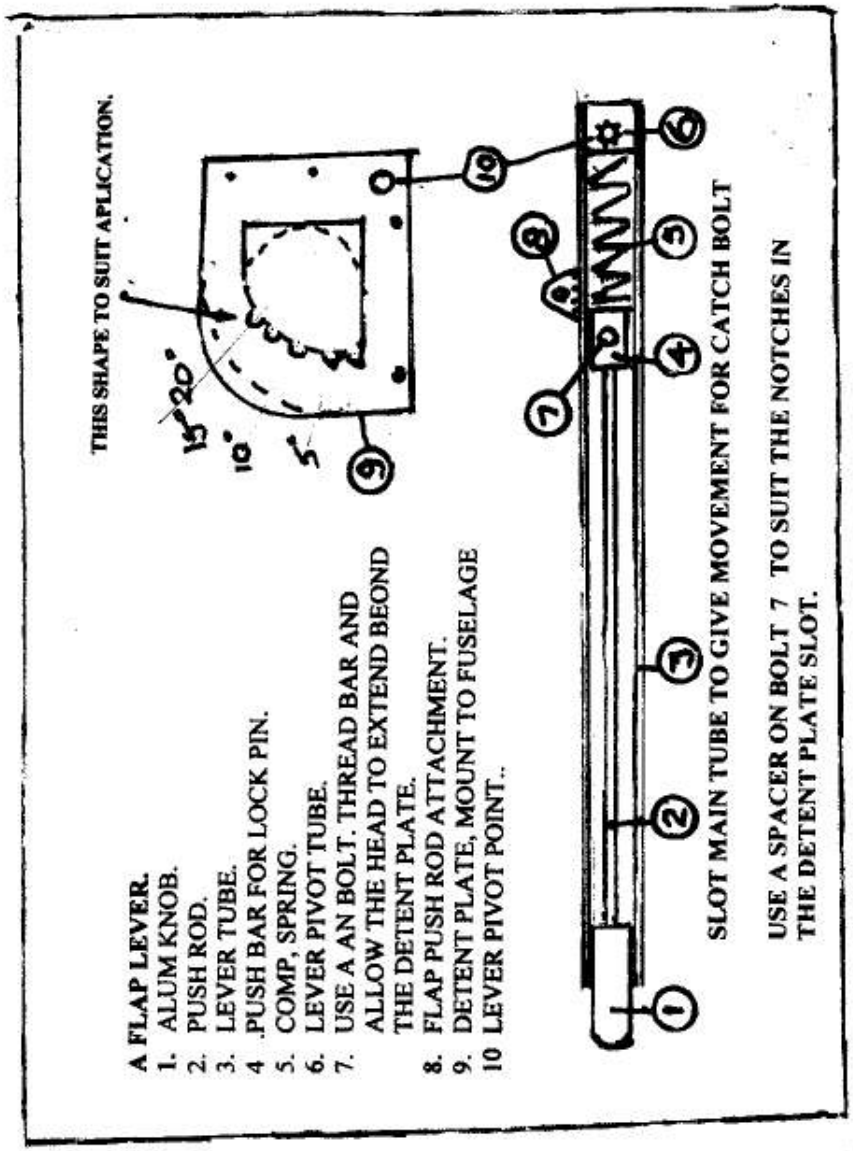


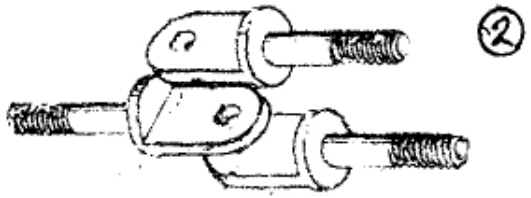
FINISHED COWLE.


NOSE SECTION G.R.P. MOULDED WITH AIR HOLES TO SUIT. ATTACH TO SIDE RAILS AND LOWER SECTION. USE ALUM. BACK PLATES WITH RIVETS OR SCREWS. BOND PLATE TO EITHER ONE.
LOOK AT OTHER DRG'S AND PHOTO'S FOR DETAILS. REMEMBER BRACE TO FIXED E.M. NOT RUBBER MOUNTED MOTOR PLATE.
THESE WILL BE POSITIONED TO CLEAR MOTOR PARTS.
USE CHANNEL, TUBE OR ANGLE ATTACH TO FIRE-WALL AND E.M. FRAME NOT MOTOR SPRUNG MOUNT. NOSE G.R.P. THE SAME.
IF POSSIBLE MOUNT SO EXHAUST EXITS AT THE BOTTOM.
DEPENDING ON THE MOTOR USED CUT OUTS MAY BE REQUIRED FOR CARBY., EXHAUST, OR AIR FLOW.
LOWER SECTION CAN BE FITTED SEMI PERMANENT.
TOP SIDES AND BOTTOM CAN BE MADE FROM METAL, .016" ALUM. OR FROM G.R.P. LAMINATED GLASS AND RESIN. I USE EPOXY. IT WILL REQUIRE A MOULD FOR TOP AND BOTTOM. A SIMPLE PLY STRUCTURE. SEE OTHER DETAILS ON FUEL TANKS. BACK PLATES OF ALUM, CAN JOIN NOSE SECTION.
SIDE PANELS CAN BE JOINED TO ① AND ③ WITH PIANO HINGE AS SHOWN IN CONSTRUCTION NOTES OR ANY OTHER METHOD OF YOUR CHOICE.
MOTOR COWL.

A TANK FOR A FLEA. see P27

First let me say, I do not think a metal tank is the best choice for a flea. To make it to suit the area it will be installed would mean lots of welds. Therefore maybe more chance of leaks.
I will try and describe how I have done it. A good density foam can be used to make a male mould from using 50 mm or more thick.
Bond it together to make the shape required. As there is a ply step behind the firewall the mould can drop down behind this to give more volume. You make it a little smaller to allow for the GRP build up.
I fix a tube with a flange to what will be the back of the tank. This then can be hung off you bench or mounted to a bench height post, which will allow you to revolve the mould during lay up.
I get ahead of myself a bit. shape the mould to suit the fuselage also the coaming behind the motor. When satisfied, seal it with epoxy resin as this does not effect most foams. then fill and paint the mould to get a reasonable smooth surface. This will then be waxed with mould wax and polished several times. A water based release agent is then applied. I use epoxy but you may like to use vinyl ester. I do recommend using Peel Ply if you intend doing the lay up an stages. This you apply to the lay up and smooth down (wear gloves) and when set it will peel off leaving a smooth surface ready for the next application of cloth and resin.
You say what about the tube. When you finish your lay up remove the tube. Well I don't lay up all the back I leave a square or rectangle around the tube making a way to remove the mould when finished. the mould will be broken to remove then wash out any mould release left with water. Then I bond a flat plate and rivet over this hole.
But first you need to bond in your filler neck. the drain flange, also the fuel take off To save having another pipe at the bottom of the tank I fit the fuel line in through the top and back of the tank. How you say. Use 6 or 8mm soft aluminum tube which you drill many small holes in one end (debure inside) this becomes your course screen. then flatten the end to seal to a small slot In the back of the tank drill a hole on an angle near the top to one side for the tube. Insert and bend down and across the bottom. Glass over this tube in a couple of places. leaving no fibers that can break off to block jets. Bond around the pipe outlet. A suitable connector or flare the end for fuel line tube . after this is when you fit the cover. As the front of the tank will sit on the ply at the front only mount angles will need to be bonded in there but to the rear a strap joined to the rear 2 angles will pass over the tank. These angles can then be bolted to the top longerons. The fuel line goes down to a fuel tap mounted on the fuse. This has a primer bulb in it.
One thing I forgot is where you fit the water drain flange you will need to shape a small sump shape to trap any water that may get in.
I do hope this is enough information to get you started



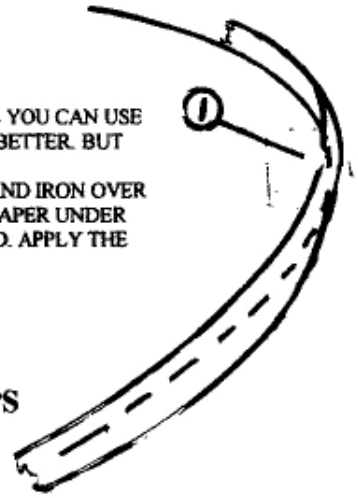


EYE BOLTS FOR RUDDER HINGES.

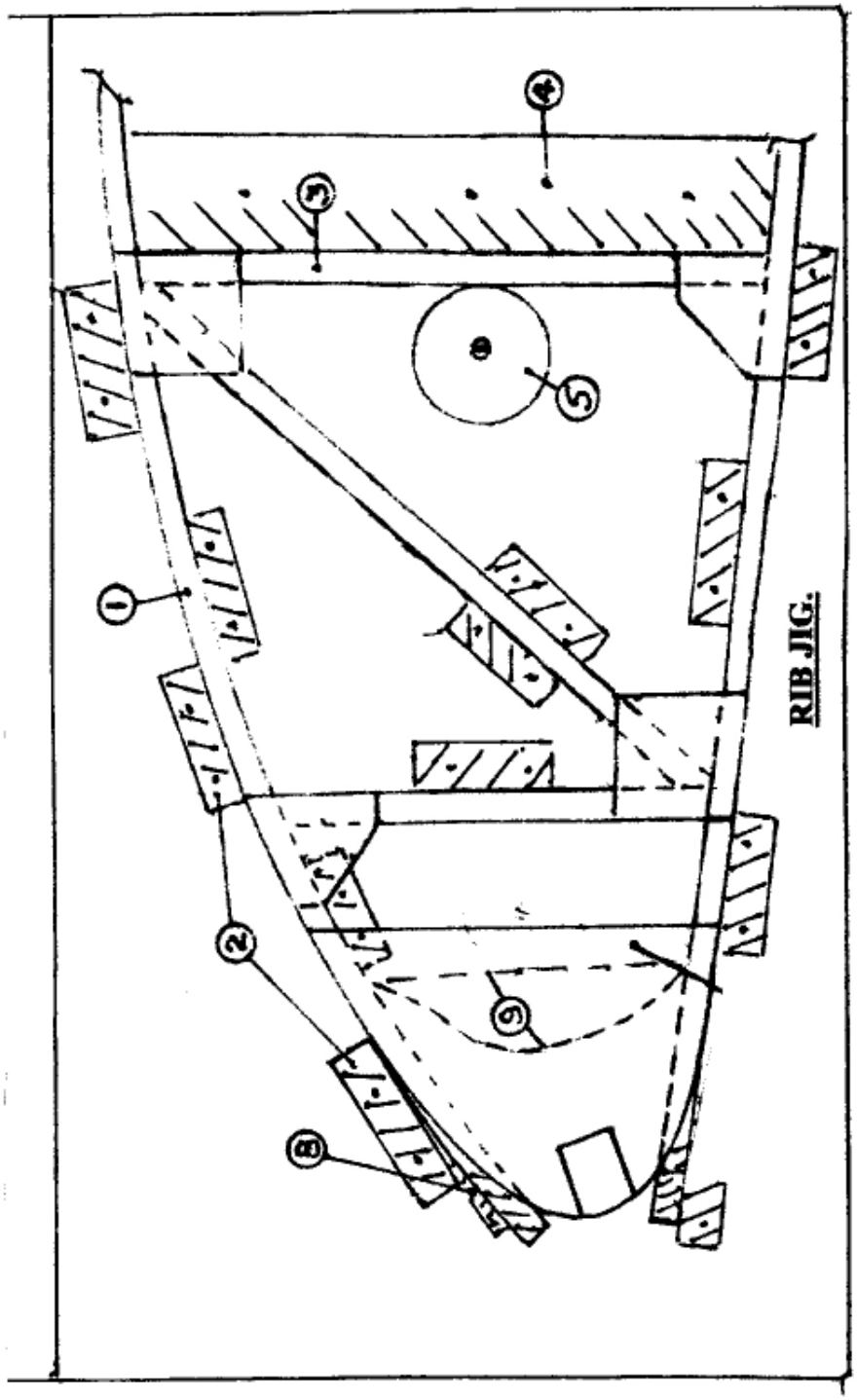
(1) **DO NOT USE, THEY MAY TURN IF THEY COME LOOSE.**

(2) **KEEP THE 2 CLOSE TOGETHER AND USE SPACERS OR WASHERS TO CENTRALISE THE SINGLE EYE BOLT. USE A WASHER PLATE ON THE NUT SIDE.**

TAPES. WHEN TAPING AROUND CURVES YOU CAN USE BIAS CUT TAPE (45 DEG) IT WILL FORM BETTER. BUT IS COSTLY IN TAPE.
NORMAL TAPE, START IN THE CENTER AND IRON OVER THE CURVE, USING A PIECE OF CRAFT PAPER UNDER THE TAPE. NICK THE TAPE AS REQUIRED. APPLY THE DOPE BY BRUSH UNDER THE TAPE.



TAPING THE WING TIPS

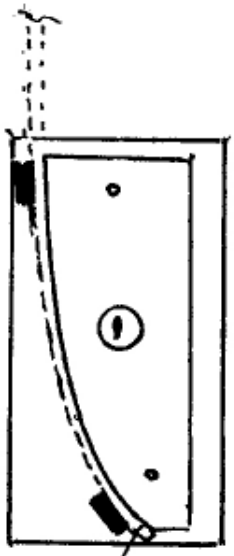


PTO

RIB JIG LAYOUT:

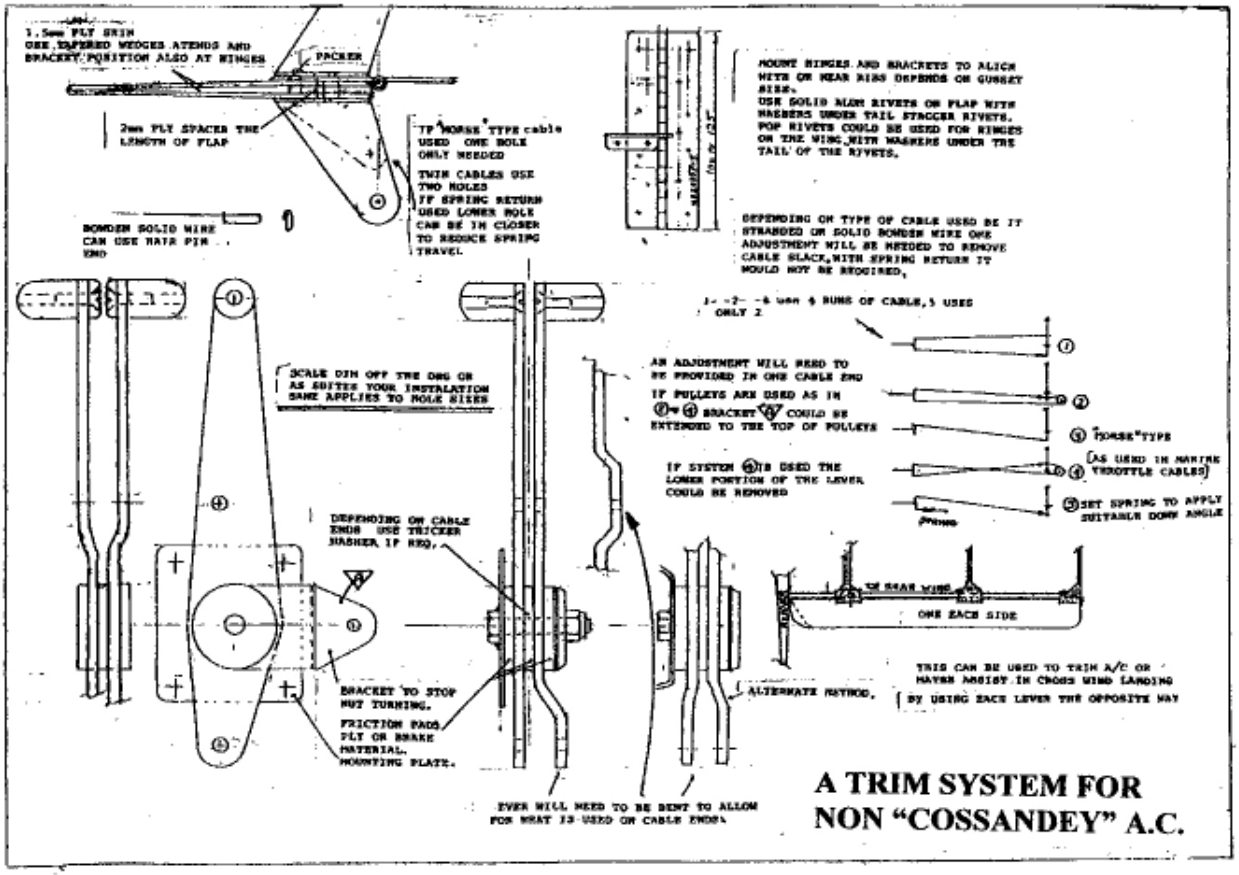
1. SOAK RIB CAP STRIPS ENDS IN HOT WATER AND BEND AROUND A DRYING FRAME MADE FROM TIMBER SCRAPS OR PARTICAL BOARD. WHEN DRY FIT TO THE JIG USE AS MANY BLOCKS 2 AS REQUIRED TO KEEP THE OUTSIDE PROFILE CORRECT. THE MORE CARE YOU TAKE WITH THIS THE LESS SANDING OR CORRECTION WILL BE NECESSARY WHEN FITTING THE "D" NOSE PLY.
3. IT IS MOST IMPORTANT TO HAVE THIS MEMBER A CLOSE FIT TO THE JIG BLOCK. USE PLY CAM DISKS TO HOLD FIRM. THESE CAN BE USED IN ANY POSITION TO KEEP THE PROFILE CORRECT.
4. THIS JIG BLOCK WILL ALSO, IF THE CORRECT LENGTH GUIDE THE CAP STRIP.
5. A CAM DISC APPROX 35MM DIA WITH SCREW HOLE OFFSET AND SCREW NOT FULLY TIGHT.
6. PLY GUSSET.
7. MAKE A THIN SHEET METAL TEMPLATE FOR THR RIB PROFILE USING THE FACE OF No 3 AS A REFERENCE, MARK NOSE SHAPE AND L.E. CUT OUT.
8. IT MAY BE NECESSARY TO USE SMALL WEDGES TO ADJUST THE SHAPE.
9. NOSE BLOCK CAN BE SHAPED OR LEFT STRAIGHT BACKED.

ONE FURTHER NOTE IF YOU ARE USING THE OPEN END SPAR I WOULD SUDJEST YOU USE A 10MM VERTICAL FRONT AND BACK OF THE SPAR FOR THR RIBS AT THE FOLDING JOINT RIBS.

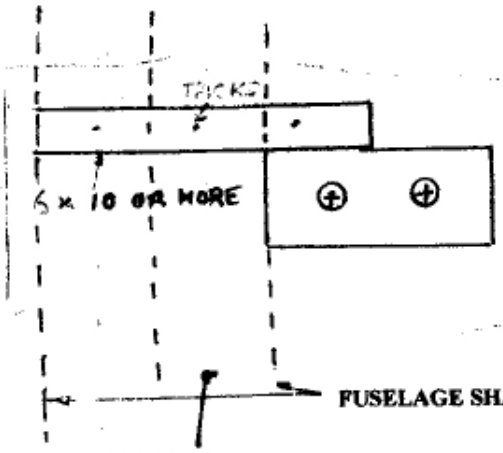


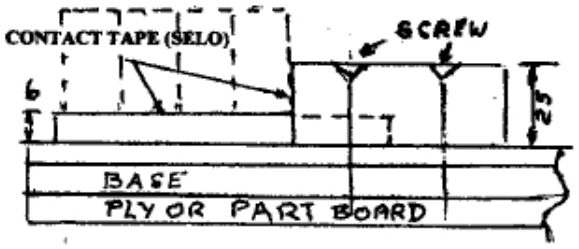
CAP STRIP.

RIB JIG CONT,.


PACKER
2mm PLY SPACER THE LENGTH OF FLAP
BOWDEN SOLID WIRE CAN USE HAIR PIN . . END
IF "HORSE" TYPE cable USED ONE HOLE ONLY NEEDED
THIN CABLES USE TWO HOLES IF SPRING RETURN USED LOWER HOLE CAN BE IN CLOSER TO REDUCE SPRING TRAVEL
MOUNT HINGES AND BRACKETS TO ALIGN WITH OR NEAR RIBS DEPENDS ON GUSSET SIZE.
USE SOLID ALUM RIVETS ON FLAP WITH WASHERS UNDER TAIL STAGGER RIVETS. POP RIVETS COULD BE USED FOR HINGES ON THE WING WITH WASHERS UNDER THE TAIL OF THE RIVETS.
DEPENDING ON TYPE OF CABLE USED BE IT STRANDED OR SOLID BOWDEN WIRE ONE ADJUSTMENT WILL BE NEEDED TO REMOVE CABLE SLACK, WITH SPRING RETURN IT WOULD NOT BE REQUIRED,
1- -2- -4 use 4 RUNS OF CABLE, 3 USES ONLY 2
SCALE DIM OFF THE DRG OR AS SUITES YOUR INSTALLATION SAME APPLIES TO HOLE SIZES
AN ADJUSTMENT WILL NEED TO BE PROVIDED IN ONE CABLE END
IF PULLEYS ARE USED AS IN 7 & 8 BRACKET 6 COULD BE EXTENDED TO THE TOP OF PULLEYS
IF SYSTEM 4 IS USED THE LOWER PORTION OF THE LEVER COULD BE REMOVED
"HORSE" TYPE
(AS USED IN MARINE THROTTLE CABLES)
SET SPRING TO APPLY SUITABLE DOWN ANGLE
DEPENDING ON CABLE ENDS USE THICKER WASHER IF REQ.
BRACKET TO STOP NUT TURNING.
FRICTION PADS PLY OR BRAKE MATERIAL.
MOUNTING PLATE.
ONE EACH SIDE
ALTERNATE METHOD.
THIS CAN BE USED TO TRIM A/C OR HAVEN ASSIST IN CROSS WIND LANDING BY USING EACH LEVER THE OPPOSITE WAY
EVER WILL NEED TO BE BENT TO ALLOW FOR WHAT IS USED ON CABLE ENDS

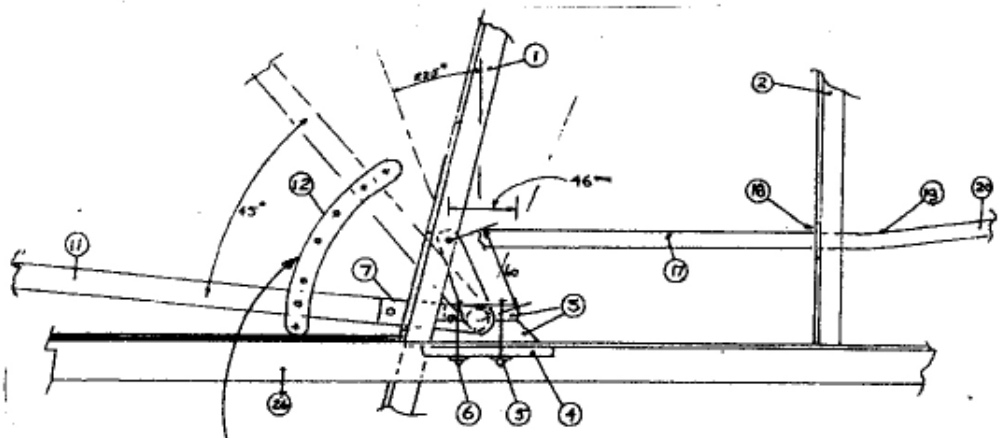
A TRIM SYSTEM FOR NON "COSSANDEY" A.C.

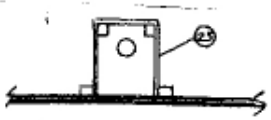




FUSELAGE CONSTRUCTION BLOCKS.

YOU CAN USE PLY OR PARTICAL BOARD MOUNTED ON TRESSELS OR A PERMANENT BENCH TOP
DRAW OUT TOP LONGERON SHAPE MOUNT THESE BLOCKS OR SIMILAR. THIS WILL GIVE AND KEEP THE SHAPE AS YOU CONSTRUCT.
TAKE NOTE OF WHERE THE FRAMES GO AND EVOID THOSE EXACT SPOTS.
AS WELL AS CLAMPING THE LAMINATIONS TOGETHER CLAMP ON TOP TH KEEP THE THICKNESS CORRECT. I HAVE DRILLED HOLES IN THE JIG SO CLAMPS CAN BE FITTED THROUGH.

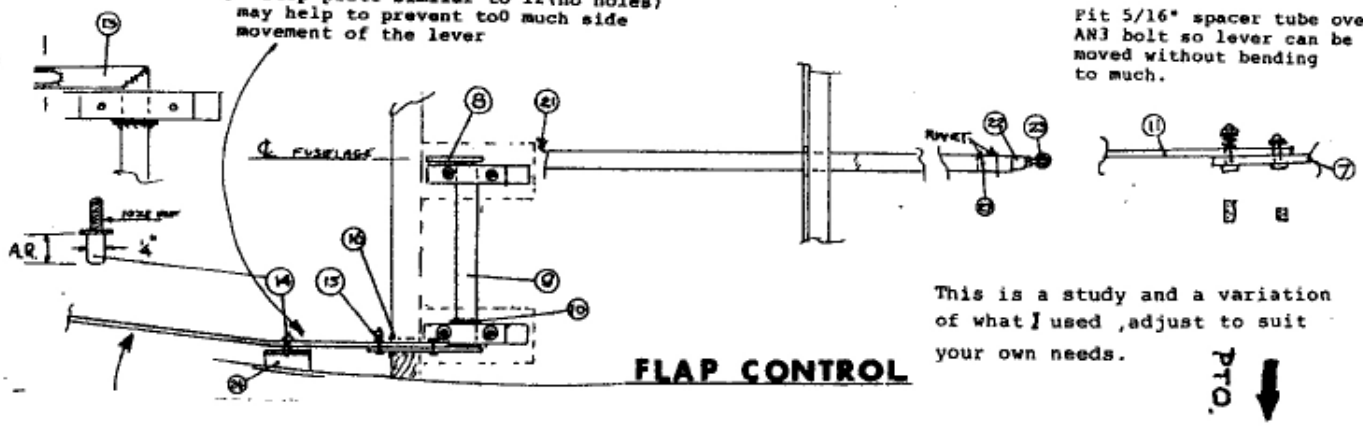




A cover could be fitted over push rod

A stop plate similar to 12(no holes) may help to prevent too much side movement of the lever

Fit 5/16" spacer tube over AN3 bolt so lever can be moved without bending to much.



FLAP CONTROL

This is a study and a variation of what I used ,adjust to suit your own needs.

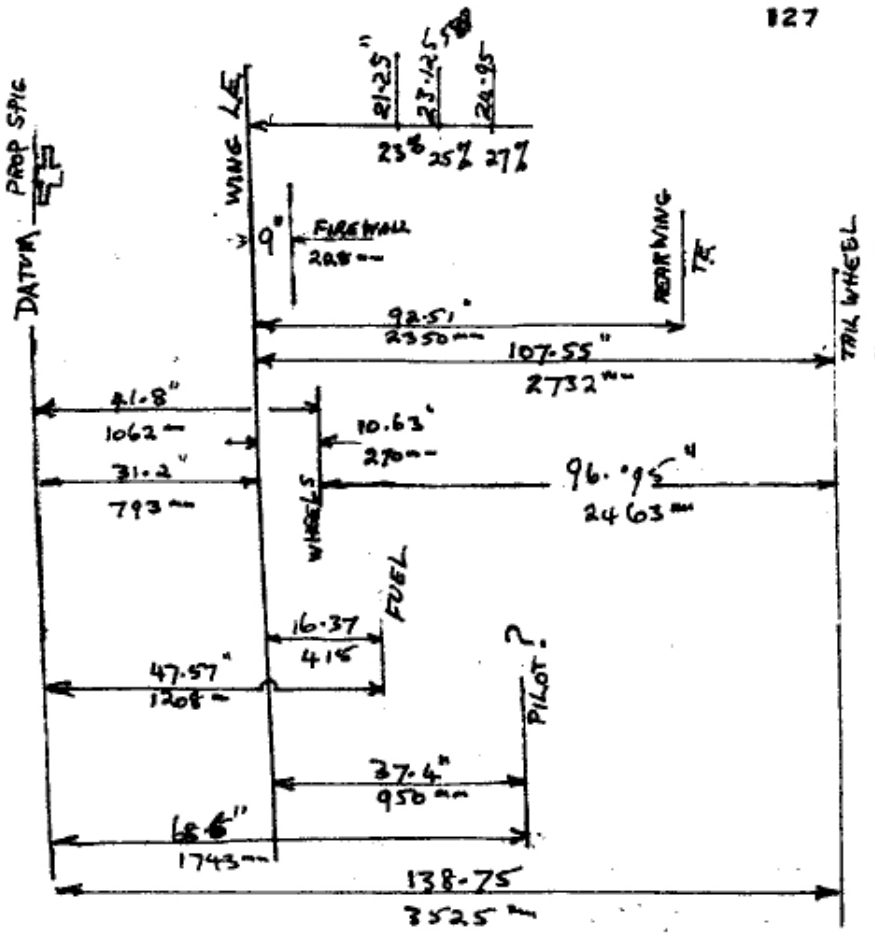
PTO.

NOTE.
SOME OF THE PARTS OF THIS ASSEMBLY SHOULD BE FITTED BEFORE THE PORT SIDE FUSELAGE PLY IS FITTED, THE QUADRANT AND LEVER CAN BE DONE AFTER THE PLY IS FITTED.

1. Seat back.
2. Rear luggage comp.
3. H.W. blocks 20x20 clamp together and drill for 1032 bolts then drill ⅝ for flap shaft do both sets the same.
4. 5 or 6mm reinf,plates ply
5. 1032 bolts.
6. 1032 nut plates.
7. .125" end plate.
8. .125" end plate.
9. ⅝"x.036" tube.
10. Washer weld or braze.
11. Flap lever say 3 or 4mm 2024 t3 or similar.Must have enough spring for indent pin to be withdrawn from quadrant plate.Adjust lever for length and bends to suit fuseelage side.A lot of this will depend on your seat position etc
12. Quadrant plate use 2½ or3mm st.steel this saves paint being scratched (m.s. or alloy if you wish) It may need a 3 rd screw near the mid ppoint.
13. Alternant end-use what suits your push rod end.
14. Ident spiggot.
15. Bolt withspring -may be needed depending on amount of spring in lever.
16. Slot in ply next to vertical member.
17. push rod say ⅝" or ½" 2024T3
18. Hole in ply to clear push rod.
19. Bend here as reqd,,
20. Rod travel app 46mm check when rear wing fitted with flap.
21. Push rod end left off for clarity.
22. Alloy plug drill and tapfor rod end.
23. Rod end ⅝unf.
24. Blocks glued to fuselage side to position Qad 12.

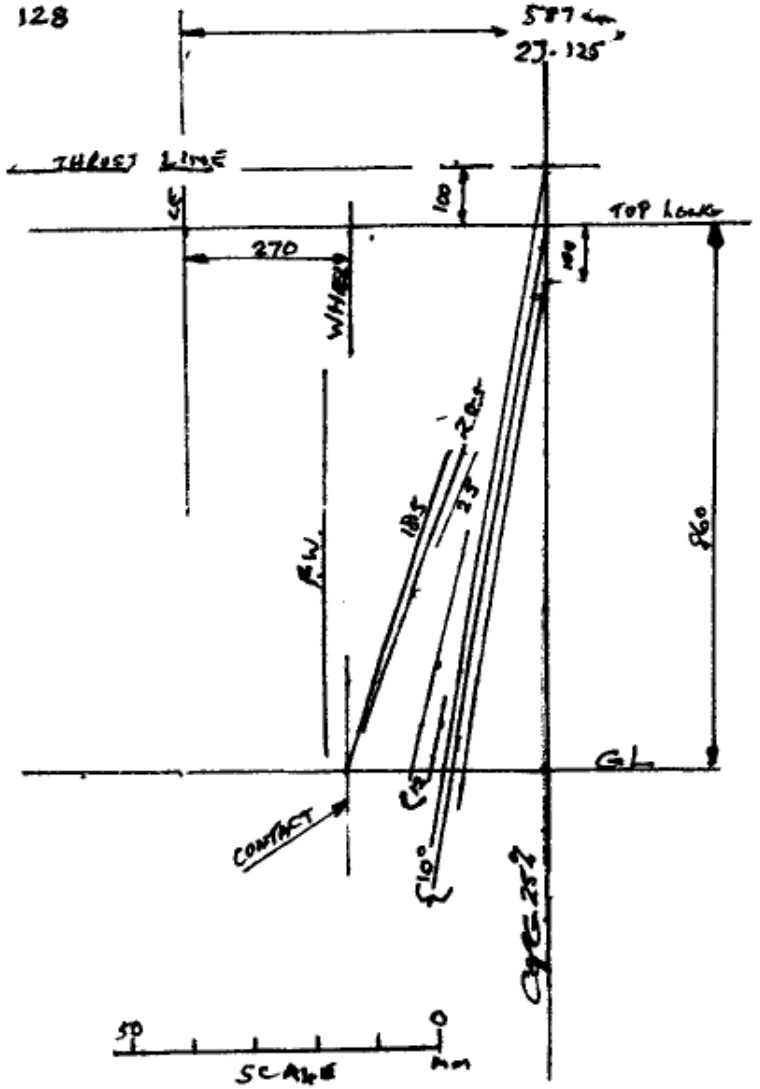
NOTE.
A system using "Morse" or "Teleflex" type cable may do the job as well.

If cable system is used the tube assy ⑨ could be much shorter.



CofG CALCULATION DIMENTIONS.

FOR HM 290/3FB REG No 10-1438.

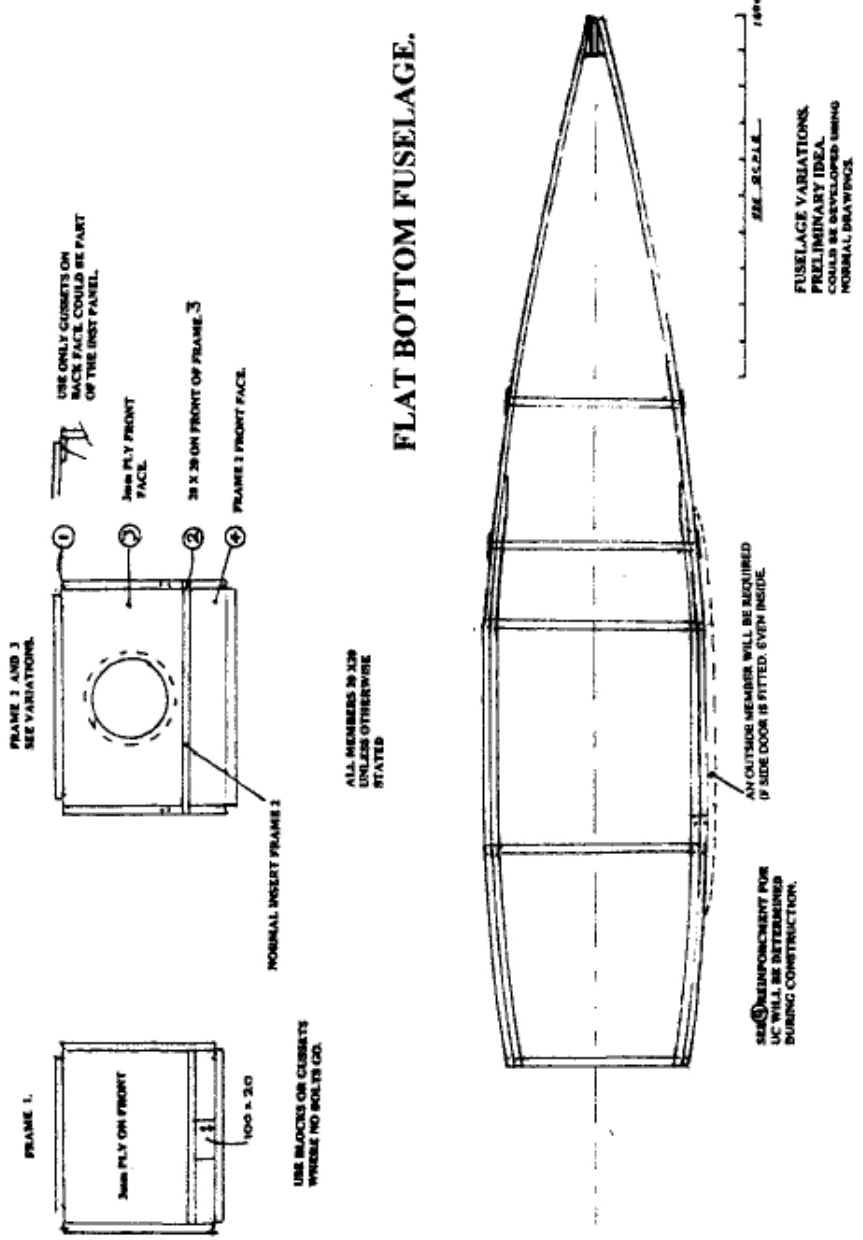


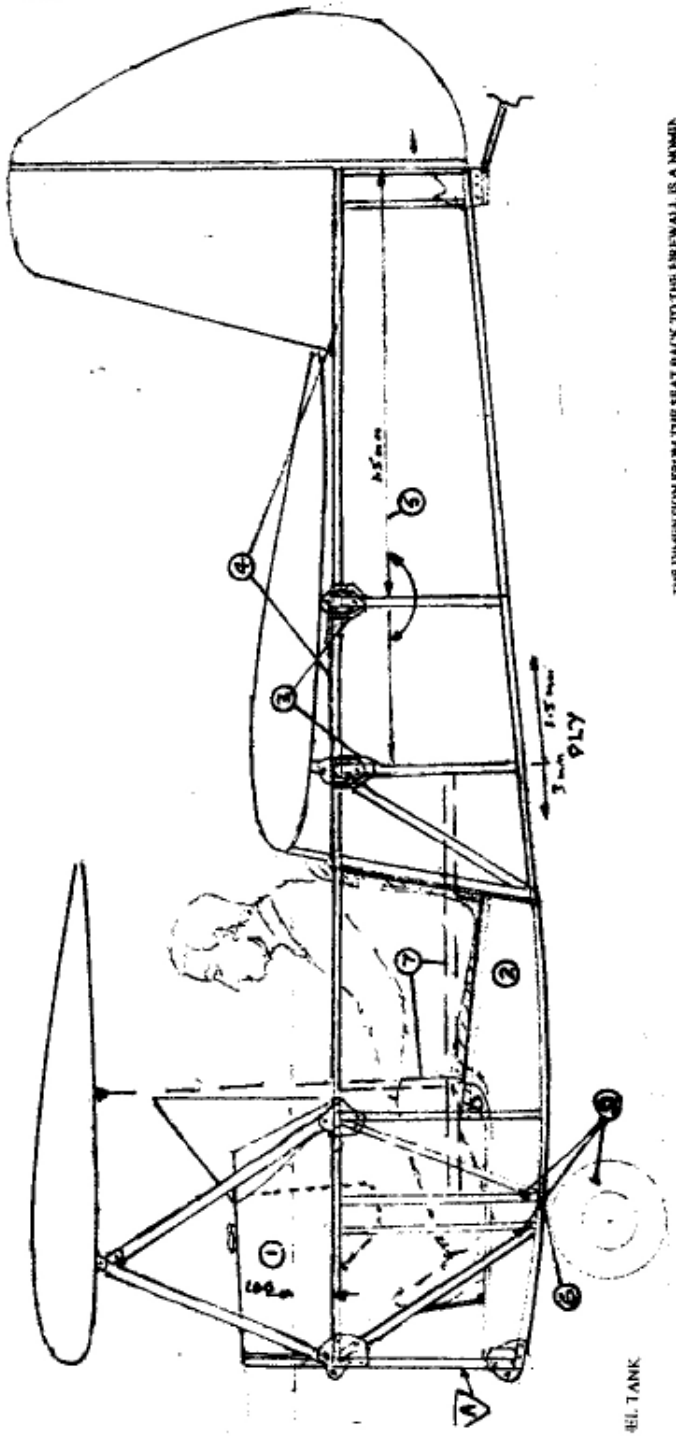
10° and 12° MAYBE IDEAL.?
18.5°—20.5°—25° ARE WHERE IT COULD BE DEPENDING ON THE VERTICAL CofG.
THE 860mm TOP LONGERON HIGHT IS AS NEAR AS I CAN DEVELOP AS THE AC IS 3.5HRS AWAY.

POSITION OF UC LOCATION.

HM 290/3FB REG No 10-1438

FLAT BOTTOM FUSELAGE.


USE ONLY GUSSETS ON BACK FACE. COULD BE PART OF THE INST PANEL.
3mm PLY FRONT FACE.
38 X 38 ON FRONT OF FRAME 3
FRAME 3 FRONT FACE.
FRAME 1 AND 3 SEE VARIATIONS.
NORMAL INSERT FRAME 2
ALL MEMBERS 38 X 38 UNLESS OTHERWISE STATED
FRAME 1.
3mm PLY ON FRONT
100 x 20
USE BLOCKS OR GUSSETS WHERE NO BOLTS GO.
AN OUTSIDE MEMBER WILL BE REQUIRED IF SIDE DOOR IS FITTED. EVEN INSIDE.
SEE REINFORCEMENT FOR UC WILL BE DETERMINED DURING CONSTRUCTION.
FUSELAGE VARIATIONS. PRELIMINARY IDEA. COULD BE DEVELOPED USING NORMAL DRAWINGS.



THE DIMENTION FROM THE SEAT BACK TO THE FIREWALL IS A NOMIN
ONE. I SUJDEST YOU SIT AND MESURE FOR YOURSELF WHAT IS COMFR
ADJUST THE FRONT FLOOR HIGHT TO SUIT, DEPENDING UC TYPE SELI
THE SAME FOR THE CONTROLS
EVEN THE SEAT HIGHT CAN BE LOWERED W THE PILOT HIGHT IN TAI
OR PACKING FOR THE SHORTER PILOTS

SCALE

0 1000mm

A FUSELAGE VARIATION STUDY.

A VARIATION OR COMBINATION OF HM293 AND HM14. (PELIMINARY).

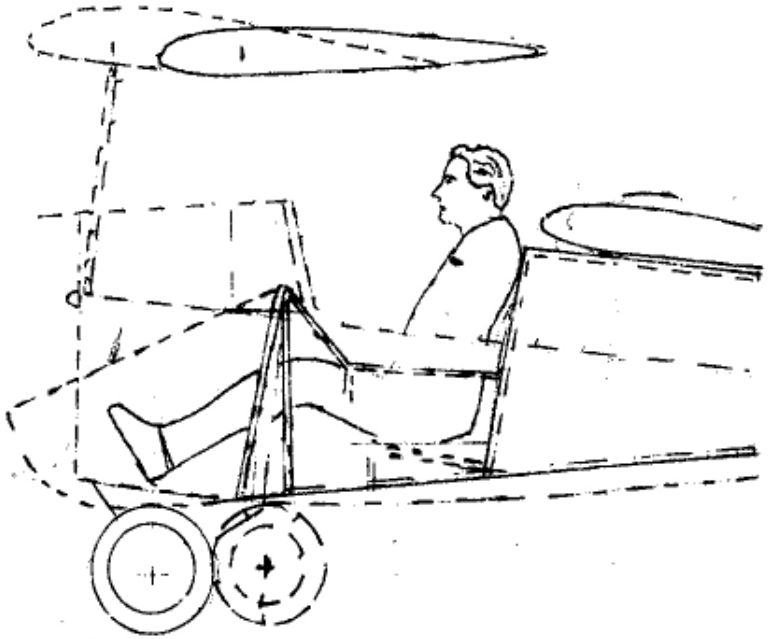
THIS LOWERS THE FUSELAGE FOR BETTER VISION AND REAR WING DRAG DURING TAKE OFF AND LANDING.

1. NORMAL FUEL TANK.
2. ADITIONAL FUEL COULD BE MOUNTED UNDER THE SEAT AND FRONT FLOOR. THIS MAY INTERFEAR WITH ACCESS TO UC MOUNT BOLTS ETC.
3. ADD PLY DOUBLERS HERE AND INSIDE.
4. TOP OF THE FUSELAGE PLY COVERED 1.5MM ? LEAVE ROOM FOR COSSANDEY FLAP LEVER.
5. USE 3MM FWD, OF FRONT OR REAR SPAR POSITION AND 1.5MM BEHIND. SAME OB BOTTOM OF THE FUSELAGE.
6. UC CAN BE THE BANTAM TYPE. AVAILABLE IN SINGLE SEAT VERSION OR A PULTRUSION ARRANGMENT.
7. DEPENDING WHICH SIDE HAND STARTING (PROP SWINGING) AN ACCESS FLAP CAN BE INSTALLED OR EVEN LEFT OUT. IT WILL REQUIREA REINFORCING BEAM BOTH EXTERIOR AND INTERIOR WITH PLY BIT INSIDE. THIS WILL MAKE ACCESS SIMPLE. A SIDE STICK AND PEDALS WILL LEAVE ROOM FOR. YOU NAME IT.
8. **THE MOTOR WILL REQUIRE ITS THRUST LINE 100mm ABOVE THE TOP LONGERON. THE MOTOR CAN BE INSTALLED UP OR DOWN DEPENDING THE MOTOR TYPE. I USED A 503 ROTAX. A 4 TO 5 DEG DOWN THRUST AND A 3-TO 4 DEG SIDE THRUST DEPENDING ON THE MOTOR ROTATION. THE PROP DIA FOR A 503 IS 60 TO 62 IN. AS FOR THE COWLE'S JUST SIDE PLATES AND A ROUNDED BOTTOM PLATE IN METAL OR GLASS. EVEN FULL ONES. I LIKE THE ONES USED ON THE TAHITI FLEAS**
9. **SOME STUDIES FEEL THE UC POSITION SHOULD BE FURTHER BACK.. THIS IS ONE REASON WHERE A FLAT BOTTOM FUSELAGE IS A HELP BY LEAVING ITS POSITION TILL LATER IN CONSTRUCTION AND C OF G CHECKS DONE IT MAY BE SIMPLER. ONE MAIN THING IS, PROP DIA TO GIVE GROUND CLEARANCE.**

THE DIMENTIONS FROM THE SEAT BACK TO THE FIREWALL IS A NOMINAL ONE. I SUBJEST YOU SIT AND MESURE FOR YOURSELF. YOU CAN ADJUST THE FRONT FLOOR AND SEAT HIGHT TO SUIT.

HM-14 COMPARRIISON TO HM-380.

IN THIS VIEW I HAVE PLACED THE HM 14 TYPE SIDE VIEW OVER A HM380 SIDE VIEW FOR COMPARRISON . YOU WILL NOTE THAT THE U.C IS WELL FWD. COULD BE MOVED BACK TO THE NORMAL HM 14 POSITION.
ONE OF THE OTHER STYLE U.C COULD BE USED, SHOWN ELSWHERE.
THEY COULD ALSO BE USED ON THE HM 290/3 TYPES. THERE IS ONE PROVISER THAT WITH THE FIXED WOODEN TYPE YOU MAY HAVE TO ADD TIMBER TO THE CURVED SIDES OF THE FUSELAGE WHERE THE HINGE GOES. THIS BEING TO HAVE A STRAIGHT SECTION TO BOLT TO.

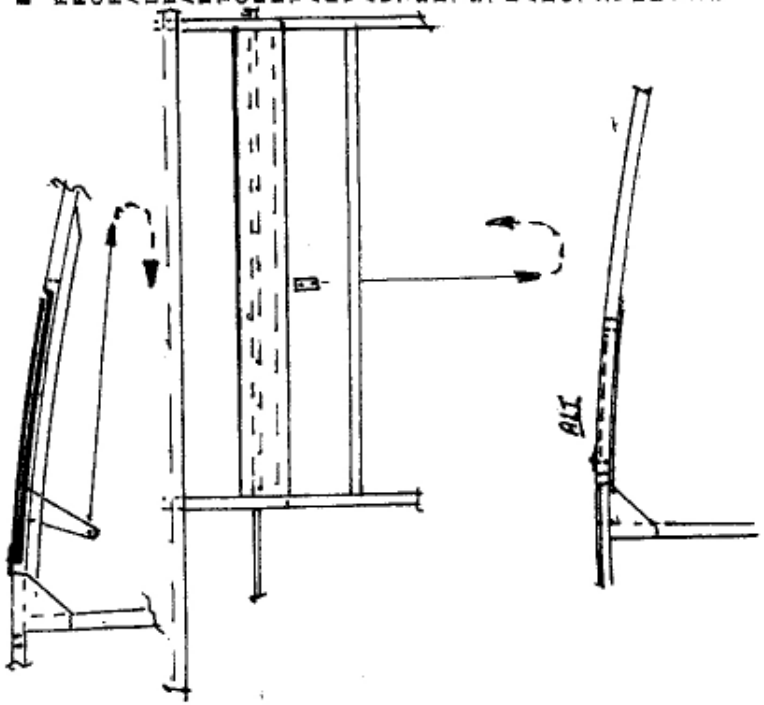


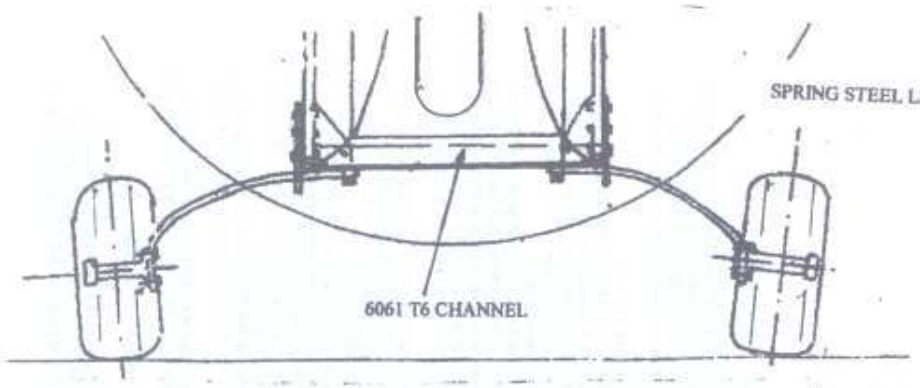
FOR A.C WITH NO "COSANDEY FLAP"

MAY HELP FOR TRIM.

REAR WING SPOILERS.

FIT A REINFORCEMENT UNDER THE RIBS AND MAKE A CUT OUT IN RIB CAP. FIT A 1.5MM PLY BASE AND SERROUNDING TIMBER, TO CREAT A POCKET BETWEEN 2 RIBS. STATIONED OUTSIDE THE FUSELAGE AND PILOT LINE. MAKE AND EXTEND FROM THE SPAR AATTACHMENT FOR THE HINGE.
IF YOU HAVE GIRDER RIBS ADJUST TO SUIT.
BECAUSE THE RIB SLOPES BACK AND DOWN , OR WHEN THE WING IS AT REAAST ON THE GROUND, FIT A SMALL DRAIN FITTING AT THE REAR OF THE POCKET WITH A SHORT PIECE OF ALUM, OR PLASTIC TUBE LONG ENOUGH TO PASS THROUGH THE LOWER FABRIC. IF PUT CLOSE TO THE RIB IT CAN BE SUPPORTED.
DRAW OUT FULL SIZE WHAT YOU DEVELOP AND WORK OUT WHAT LENGTH AND ANGLE THE OPERATING LEVER WILL BE. ATTACH TO THE .045" OR .063" ALUM, SPOILER PLATE, WHICH WILL BE HINGED AT THE FRONT WITH A PIANO HINGE PIECE.
REMEMBER TO SEAL THIS POCKET WITH THE FABRIC TUCKED IN WHEN COVERING YOUR WING.
A SIMPLER ALTERNATIVE IS TO JUST ATTACH A 1.5MM PLY PIECE UNDER THE RIB AND FIT TIMBER TO MAKE THE POCKET.
TAKE CARE TO ALLOW ENOUGH PLY OVERLAP AT THE REAR TO STOP THE FABRIC DISTORTING THE POCKET.
NATURALLY A SLOT WILL BE MADE IN THE PLY FOR THE LEVER7.
THE OPERATING CABLE CAN BE FITTET IN PUSH BIKE OUTER SHEATH ATTACHED IN APROPIATE PLACES TO MAKE THE CURVE TOCHANDGOB DIRECTION BACK TO THE COCKPIT AREA....STRAIGHT RUNS WOULD NOT NEED AN OUTER SHEATH.
ATTACH TO A BIKE TYPE GRIP ON THE STICK OR A KNOB IN EASY REACH, AS USED IN SOME GLIDERS. EBVEN A SIMPLE LEVER IN EASY QUICK REACH.
THE SIZE OF THESE SPOILERS I AM NOT SURE OF BUT WOULD TRY 300MM X SAY 75MM, THE IDEA IS TO REDUCE THE LIFT ON THE REAR WING.
MAYBE A YARN TO GLIDER PEOPLE WOULD GAIN SOME KNOWLEDGE.
BY THE WAY PUT THE HINGE ROUND PART POINTING DOWN IN FRONT OF THE SPOILER PANEL. ATTACHY WITH SNALL CSK SS SCREWS IN FRONT AND RIVETS TO THE PANEL WITH. AN OR A 426-3

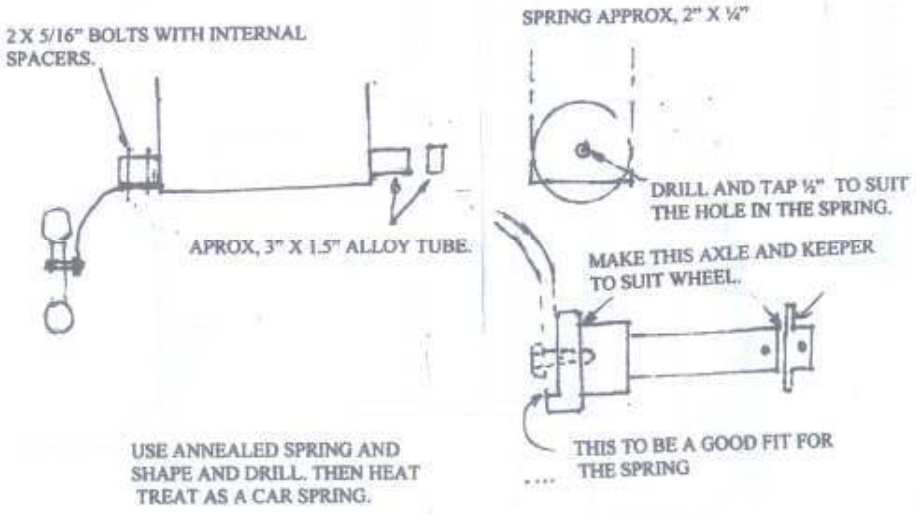


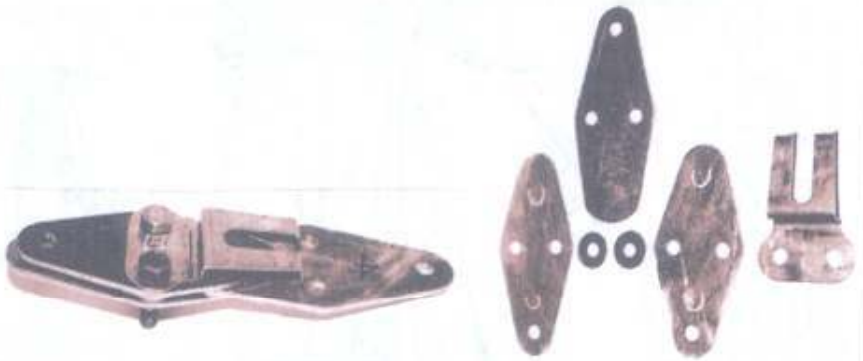


THIS IS ONE TYPE OF UC USED ON A FLAT BOTTOM 293 STYLE. OR A TUBE CAN REPLACE IT FOR THE HM14 STYLE FUSELAGE . ALLOW TO PROTRUDE ABOUT 150MM AND ATTACH THE SPRINGS WITH THROUGH BOLTS AND SPACER TUBES. USE 8MM BOLTS

A MOULDED GRP CHANNEL UC BEAM MANUFACTURED IN NEW ZEALAND IS ANOTHER OPTION.

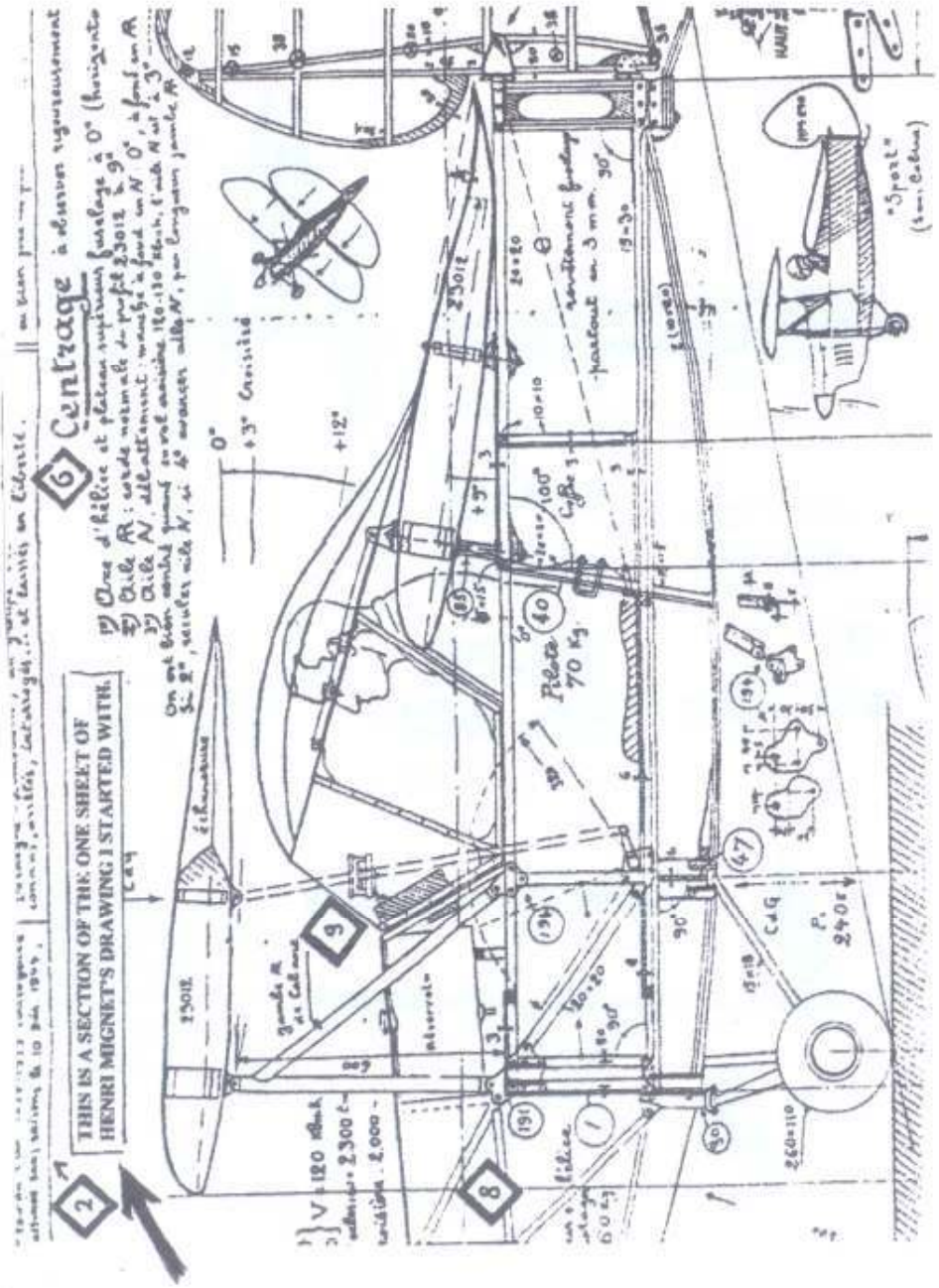
UNDERCARRIAGE VARIATION.


2 X 5/16" BOLTS WITH INTERNAL SPACERS.
APROX, 3" X 1.5" ALLOY TUBE.
USE ANNEALED SPRING AND SHAPE AND DRILL. THEN HEAT TREAT AS A CAR SPRING.
SPRING APPROX, 2" X ¼"
DRILL AND TAP ½" TO SUIT THE HOLE IN THE SPRING.
MAKE THIS AXLE AND KEEPER TO SUIT WHEEL.
THIS TO BE A GOOD FIT FOR THE SPRING



FITTINGS AS MADE BY ROY de STADLER.
A Flea builder in South Africa using these plans.

YOU WILL NOTE THAT THE TOP HING'S ARE TO DRG 27-28 AS USED ON THE HM-360/80. Also the rear one uses a 2 bolt to the spar as in the older type. This means you don't have to add the small tubes.



THESE PHOTOE'S ARE OF A LOAD TEST I DID TO EVALUATE THE FOLDING JOINT FITTINGS. I USED MILD STEEL, COMERSIAL BOLTS FOR MOST OF IT. THE TIMBER AND PLY WAS OF POOR QUALITY AND NOT MUCH CARE WAS TAKEN IN THE MAKING. (A SLOPPY JOB).
THE WING PROOF LOAD WAS NORMAL. THE BLOCKS ARE SOLID LEAD. THE HINGES ARE AS HM380 BUT THE SPAR SIZES ARE FOR HM290/3.THE WING USED IS AHM290/3 BUT USED ON A HM14.

A BIT MORE RAMBLING ABOUT THIS AND THAT.

It would pay if you can find some photo's or video of Danny Elber's Flea. It has a flat bottom—fixed UC—and he swapped from rudder on the stick to pedals and found it was superior.

If I was to build another (I hope I do) I would use a flat bottom, Fixed UC or close to it. Definitely pedals or rudder bar. I considered this way back. In the case of pedals a linkage between them to maintain tension, or a balance spring device as used in the Jodel. A side stick, leaving room for knuckles, as no side movement would be required. A fin and rudder again. Ever effort made to lower the AC for better vision and lower drag for take off.

The timber used would be tested to allow for possible reduction in sizes within allowable tolerances. !.5mm Ply behind the rear wing pick up point. Every effort to reduce the chance of getting the CofG to the rear. The cut out in the front wing reduced to still allow the look over the wing in turns.

The round bar tail wheel spring proved a worth wile effort. P109

The drill Jig is worth making. And long bolts through the front wing pivot point a good thing.

Back to UC now there is a single seat GRP version of the NZ Bantum. Also the Hi Max fixed UC. The Rag Wing bungee type are all worth considering. In the case of the HI Max type, or similar using the hinge attachment it would be required to add some timber on the fuselage lower edge to develop a straight mounting edge.

Th holes in the ply on the fuselage top behind the seat back need the one where the "Cossandey" flap lever goes is positioned to suit when the rear wing is fitted.

The ASI Pitot head need be no more than a 6mm alloy tube fitted in the Leading edge in the centre section at the folding joint. Reinforce this area during construction to allow for the 6mm hole. I leave the tube protruding by about 30mm then using a piece of plastic tube and the ASI tube protruding a further 160mm approx, You wonder why, well as sure as apples grow on trees some Dill will try to wipe it off as the pass by. But all is not lost because of where you mounted it the hole in the end rib gives access. One more thing CSK the tube in its forward end on the inside. WHY well back in 1959 we the DCA and myself had the use of the wind tunnel at one of our universities to conduct tests to see at what angle the pitot's lost ~~there~~ effectiveness. This tube gave the best results. We tried lots of shapes and sizes.

	X	0	3.75	7.5	15	30	45	60	90	120	180	240	300	360	480	600	720	840	960	1080	1140	1200
"A"	+y	15	24.2	29.6	37.5	49.9	59.8	68	82	93	107	115	116	114	104	89.2	72.4	55.2	37.5	18.9	9.6	0
	-y	0	6.1	9.6	13.7	17.5	20	22.2	25.6	28.8	34.7	38.7	42	44.3	46	47.5	45.8	41	33.8	22.4	14	0
	X	0	3.4	6.8	13.75	27.5	41.2	55	82.5	110	165	220	275	330	440	550	660	770	880	990	1045	1100
"B"	+y	14	22.3	27.2	34.5	45.8	54.9	62.6	75	85.4	98.5	105.4	107	105	95.5	81.8	65.5	50.6	34.2	17.2	8.85	0
	-y	0	5.62	8.8	12.6	16	18.5	20.4	23.5	26.4	31.8	35.5	38.5	40.6	42.3	43.5	42	37.6	31	20.5	12.9	0
	X	0	2.75	5.5	11	22	33	44	66	88	132	176	220	264	352	440	528	616	704	792	836	880
"C"	+y	16.4	17.7	21.7	27.5	36.6	44	50	60.2	68.3	79	84.4	85.7	84.2	76.5	65.5	53.1	40.5	27.5	40	7.9	0
	-y	0	4.5	7	11	12.9	15	16.3	19	21	25.5	28.5	31	32.5	34.4	35	33.5	30	25	16.8	10.3	0
	X	0	1.89	3.75	7.5	15	22.5	30	45	60	90	120	150	180	240	300	360	420	480	540	570	600
"D"	+y	7.7	12	14.8	18.7	24.9	30	34	41	46.5	53.7	57.5	58.5	57.4	52	46	36.2	27.6	18.7	9.5	4.8	0
	-y	0	3	4.8	6.8	8.8	10	11	13	14.4	17.3	19.3	21	22.2	23	23.7	23	20.5	17	11.2	7	0

MIGNET 34.0.13 AIRFOIL.
Coordinates are in % cord
(Do not need this number off while multiplying by Cord Length)

This Chart Done by Richard Fraser.

STATION	(+)ABOVE CHORD	(-)BELOW CHORD
0.00000	0.013864	0.000000
0.00125	0.020261	0.000111
0.00500	0.030724	0.000413
0.01250	0.043521	0.001077
0.02500	0.05589	0.001982
0.05000	0.079964	0.003804
0.07500	0.098032	0.005524
0.10000	0.113003	0.007113
0.15000	0.137998	0.010081
0.20000	0.158007	0.012857
0.30000	0.188026	0.018167
0.40000	0.207438	0.022818
0.50000	0.218712	0.026577
0.60000	0.222000	0.029209
0.70000	0.219446	0.030529
0.80000	0.208986	0.030214
0.90000	0.190881	0.026226
0.95000	0.175135	0.020235
1.00000	0.151779	0.013086
1.00000	0.000000	0.013771
1.00000	0.000000	0.000000

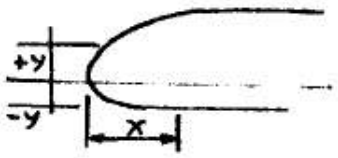
L.E. Radius 0.015385
Station 0.014437
(+) Above Chord 0.005315

NOTE The leading radius shown is for reference only. There are enough points given in that area for a smooth curve.

COORDINATES FOR 34.0.13 AIEFOIL.

THERE ARE ENOUGH CORD POINTS SHOWN TO HAVE THE NOSE RAD DEVELOP.

FOR OTHER LENGTH RIBS YOU MULTIPLY THE CORD BY THE NUMBERS SHOWN IN RICHARDS GRAPH CHART.



Page 43 - 2nd paragraph.
Please align magnet clamping the stick with your knees
To reduce lateral movement: induced roll